THE BEHAVIORS OF ROBUST WEIGHTED LEAST SQUARES ESTIMATION TECHNIQUES FOR CATEGORICAL/ORDINAL DATA IN MULTILEVEL CFA MODELS

A Dissertation

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ABSTRACT

This present Monte Carlo study was conducted to investigate the behaviors of weighted least square mean (WLSM) and weighted least square mean and variance (WLSMV) estimation techniques with categorical/ordinal data in multilevel confirmatory factor analysis (CFA) models under various conditions. Specifically, the study focused on how well WLSM and WLSMV estimation techniques work for multilevel CFA models with categorical/ordinal data by examining parameter estimates, standard error estimates of the parameters, and some of the fit indices. Also, the performance of commonly used fit indices for misspecified two-level CFA models for categorical/ordinal variables with the WLSM and WLSMV estimations was examined using traditional cutoff values for the fit indices.

Simulation results showed that WLSM and WLSMV estimated biased factor pattern coefficients and the factor correlation in the between-level regardless of the simulation design factors. In the within-level model, the factor pattern coefficients and correlation were unbiased when a large number of cluster size (CS) and a large number of clusters (NC) were used; but these parameters were biased when a small NC and CS were used. Standard error estimates of the parameters in both within- and between-levels were biased regardless of the design conditions, so parameters should not be evaluated based on statistical significance test results even when these parameter estimates are unbiased.

The chi-square overall model test statistics were poorly estimated. WLSM or WLSMV based overall model chi-square test statistics did not follow the traditional chi-square test distribution. Because of that, lower power rates were obtained when factor pattern coefficients were misspecified in the between- or within-level models. Generally, CFI, TLI, RMSEA, SRMR for the between-level model (SRMR-B), and SRMR for the within-level model (SRMR-W) performed poorly for detecting misspecifications. As a final remark, it is better not to use robust WLSM or WLSMV estimation techniques in the multilevel CFA models when clustered categorical/ordinal data are present.

DEDICATION

To my mother, father, wife, and children

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Structural equation modeling (SEM) is among the most popular analytical methods in the educational and social sciences. SEM is a general name describing statistical methods, such as confirmatory factor analysis (CFA), path analysis, and latent growth modeling. One of the important factors in SEM models to obtain correct estimates is the estimation technique which is applied (DiStefano & Morgan, 2014). The selection for the estimation technique can be directly linked with the scaling level of the data. The choice of the estimation method based on the scaling data is crucial to obtaining correct parameter values, standard errors, and fit indices (Finney & DiStefano, 2006).

When data are collected on a continuous scale, the most commonly used estimation technique in SEM is Maximum Likelihood (ML). The ML estimation technique falls under the family of normal theory estimators, which requires certain assumptions to obtain correct results. These assumptions (e.g., Bollen, 1989) are (a) independence of the observations, (b) sufficient sample size, (c) a correctly specified model reflecting the structure in the population, (d) multivariate normality, and (e) continuous data.

Although the ML estimation technique requires that collected data are on a continuous scale and are multivariate normal, in educational and social sciences it is common to collect data that are not on a continuous scale. Two types of data which are not on a continuous scale are binary and ordinal scale data. Binary data can be collected, for example, through a multiple choice exam by dichotomously coding correct answers “1”, and incorrect answers “0”. Ordinal scale data can be collected via a Likert-type scale instrument. When the data are not on a continuous scale, expecting the data to follow a multivariate normal distribution is unreasonable. Normality can only occur with continuous data (Thompson, 2006). Thus, applying ML estimators to data that are not collected on a continuous scale will violate the assumption of multivariate normality. When normal theory estimators’ assumptions are violated, applying one of the normal theory estimators (i.e., ML) can produce biased model results (Finney & DiStefano, 2006).

Weighted Least Squares (WLS) estimation technique (also known as categorical variable modeling) (Muthén, 1978, 1984; Muthén & Asparouhov, 2002) is one of the major methods to analyze categorical/ordinal data. The operating framework under the WLS estimation is that categories coming from an underlying latent continuous variable by cutting this latent variable into some set of ordered categories via cut points (i.e., thresholds) (Muthén & Muthén, 2012). There are also robust versions of the WLS. Detailed information about the WLS estimation method and its robust versions, Weighted Least Squares Mean (WLSM), and Weighted Least Squares Mean and Variance (WLSMV) adjusted, are provided in the subsequent session.

Another assumption that can also be violated in all statistical techniques, including SEM, is independence of the observations because of the sampling procedure. Independence of the observations can be achieved by simple random sampling (SRS) procedure, but in educational and social sciences, cluster sampling and multistage sampling are two commonly used sampling procedures (Wu & Kwok, 2012). When data are collected using cluster or multistage sampling procedures, observations within clusters tend to have similar characteristics. The similarities of the observations violate the independence of the observations assumption. Thus, applying conventional statistical analyses to data, which are not collected by SRS, can cause incorrect statistical conclusions because of biased standard error estimates (Hox, 2002). Moreover, "by ignoring the hierarchical structure of the data, incorrect parameter estimates, standard errors, and inappropriate fit statistics may be obtained" (du Toit & du Toit, 2008, p. 456).

Design-based and model-based approaches are two commonly used statistical procedures to analyze data from cluster or multistage sampling. The design-based approach takes into account the hierarchical structure of the data and provides adjusted standard error estimates for the parameters (Wu & Kwok, 2012). In the model-based approach, hierarchical data are analyzed by specifying models for each level of data (Wu & Kwok, 2012). For example, in two-level data (e.g., students are nested under schools), while a design-based approach only requires a model for the students level data by taking into account the sampling design, a model-based approach requires models for both student and school level data.

At this point, the question arises regarding how can we analyze data that are collected on a categorical or an ordinal scale through clustered or multistage sampling? Asparouhov and Muthén (2007) provided a rationale to analyze any combination of categorical, ordinal, continuous, and censored variables when data have a hierarchical structure. They extended the Muthén's (1984) WLS estimation method to multilevel models.

Even though the rationale was provided almost a decade ago, the only study examining the performance of multilevel models for categorical variables after Asparouhov and Muthén (2007) was Hsu (2009). Clearly, more studies on the multilevel models for categorical and ordinal variables are needed.

In the present dissertation study, I examined the behavior of the robust WLS estimators (i.e., WLSM and WLSMV) for categorical/ordinal outcomes by conducting a simulation study. The study specifically focused on how well WLSM and WLSMV estimation techniques worked for multilevel CFA models for categorical/ordinal data by examining parameter estimates, standard error estimates of the parameters, and some of the fit indices (i.e., chi-square, CFI, TLI, RMSEA, SRMR-Between, and SRMR-Within). Also, the performance of commonly used fit indices (i.e., chi-square, CFI, TLI, RMSEA, SRMR-Between, and SRMR-Within) for misspecified models in a two-level CFA model for categorical/ordinal variables with the WLSM and WLSMV estimations was examined by using traditional cutoff values for the fit indices.

Recently, Hsu, Kwok, Lin, and Acosta (2015) examined the performance of commonly used fit indices in SEM literature for misspecified models in a two-level CFA model for continuous outcomes with Robust Maximum Likelihood (MLR) in Mplus. As indicated previously, one of the goals of the present study was to examine the performance of commonly used fit indices in two level CFA models for categorical/ordinal variables with WLSM and WLSMV estimations. Even though the estimations and the level of data differ between Hsu et al. (2015) and the present study, similar models and conditions were used for comparison purposes. The goal was to make some general statements for some of the fit indices with categorical/ordinal and continuous outcomes in two-level SEM models.

Before presenting the simulation study, I present some technical aspects of WLS, WLSM, and WLSMV estimators; multilevel SEM rationale for categorical/ordinal outcomes (Asparouhov & Muthén, 2007), and a literature review for methodological papers related to single-level SEM models for categorical/ordinal variables, and multilevel SEM models for categorical/ordinal variables.

WLS, WLSM, and WLSMV

Muthén and Asparouhov (2002) described the WLS estimation method for categorical/ordinal variables based on Muthén's (1984) latent variable formulation. In the latent variable formulation, the observed categorical/ordinal variables y_i result from categorizing unobserved (latent) continuous variables y_i^* via thresholds (τ). The connection between y_i and y_i^* can be represented for m categories via threshold parameters such as (Muthén & Asparouhov, 2002):

$$y_i = c \; if \; \tau_c < y_i^* < \tau_{c+1} \, , c = 0, 1, 2, \dots, m-1 \, ,$$

where

$$\tau_0 = -\infty , \tau_m = +\infty .$$

Although the formulation shows the connection for ordinal variables, it can be accommodated for a specific binary variable (i.e, 0 and 1) situation:

$$y = 0 \; if \; \tau_0 < y^* < \tau_1 \; and \; y = 1 \; if \; \tau_1 < y^* < \tau_2 ,$$

where

$$\tau_0 = -\infty , \tau_2 = +\infty .$$

The WLS estimation consists of three stages to estimate the relationships among y_i^* variables. In the first stage, thresholds are estimated. These thresholds are basically z values on the standard normal distribution based on proportions of categories for an item. In the second stage, tetrachoric correlations for binary items, or polychoric correlations for ordinal items, are estimated. Third, after the estimation procedures of thresholds and correlations, parameters are estimated by fitting the WLS function (Muthén, 1984). The WLS fit function for categorical/ordinal variables (Bollen, 1989, p. 425) is:

$$F_{WLS} = [s - \sigma(\theta)]' \, W^{-1} \, [s - \sigma(\theta)] ,$$

where s includes estimated thresholds and polychoric correlations, and $\sigma(\theta)$ includes model implied thresholds and polychoric correlations. In the fit function, the weight matrix (W) includes asymptotic covariances of s. The W matrix can have numerous dimensions based on the variables in the model. The high dimensionality of the W may cause estimation problems because of the necessity of inversion of the W matrix (DiStefano & Morgan, 2014). Convergent and proper solutions can be obtained by using large sample sizes and simpler models when the WLS estimation is applied (Bandalos, 2014; Flora & Curran, 2004; Potthast, 1993). The need for large sample sizes and simpler models for proper estimations indicates that the WLS estimation technique is not a desirable estimation method when we have small sample sizes and/or complex models (Bollen, 1989).

Robust estimation techniques were proposed to overcome the weaknesses of WLS estimation. WLSM and WLSMV are two commonly used robust versions of the WLS implemented in the Mplus program. WLSM and WLSMV were first developed for binary data (Muthén, 1993), and later extended to use with any combination of binary, ordinal, and continuous outcomes (Muthén, du Toit, & Spisic, 1997). In WLSM and WLSMV, only diagonal elements of the weight matrix (V) are inverted in the fit function, not the full weight matrix (W) as in the WLS. The V matrix contains the asymptotic variances of the thresholds and polychoric correlations, and those are used to estimate parameters. To estimate standard errors of parameters, a robust asymptotic covariance matrix is used. In the calculation of the robust asymptotic covariance matrix, the weight matrix (W) is still used, but it is not inverted, so the estimation avoids problems encountered in the WLS (see Muthén et al., 1997). There are also adjustments in the goodness of fit statistics in WLSM and WLSMV estimations. In WLSM, the adjustment is applied to chi-square test statistics to approximate the expected chi-square mean, and in WLSMV, the adjustment is applied to both mean and variance of chi-square (Muthén et al., 1997). Parameters and standard errors of parameters in WLSM and WLSMV are exactly equal because of the same procedure being used in the estimation, but the fit indices can be different from each other because of the different adjustments to chi-square test statistics.

Rationale for Multilevel SEM Models for Categorical/Ordinal Variables

The rationale behind multilevel SEM models for categorical/ordinal variables is directly related to the rationale for multilevel SEM models for continuous outcomes, which was provided by Muthén (1994). Estimation of the parameters in multilevel SEM for categorical/ordinal variables follows almost the same steps in the robust weighted least squares estimation procedure, as previously explained. Actually, Asparouhov and Muthén (2007) called the new procedure “a limited-information weighted least squares estimation method” and described it as an extension of Muthén’s (1984) weighted least squares approach for single-level models. Asparouhov and Muthén (2007) formulated the method for the general SEM framework, but here, for the sake of simplicity it is formulated as a single factor two-level model.

Let y_{pig} be the p^{th}observed categorical/ordinal variable for an individual i $(i = 1, \ldots, N_g)$, in group (e.g., school) g $(j = 1, \ldots, C)$, where N_g is the number of observations within in group g. From the Muthén’s (1984) latent variable formulation, the observed categorical/ordinal variables y_{pig} result from categorizing unobserved (latent) continuous variables y^*_{pig} via thresholds (τ_{pk}). For m ordinal categories, the formulation is:

$$y_{pig} = c \; if \; \tau_{pc} < y^*_{pig} < \tau_{pc+1}, c = 0, 1, 2, \dots, m-1 \, ,$$

where

$$\tau_{p0} = -\infty \, , \tau_{pm} = +\infty \, .$$

In the latent variable formulation, the important point is that instead of categorical y_{pig} variables, multivariate normally distributed y^*_{pig} variables are modeled. Thus, Muthén's (1994) multilevel SEM model approach for normally distributed outcomes can be adjusted for the categorical/ordinal variables (Asparouhov & Muthén, 2007):

$$y^*_{pig} = \upsilon + \lambda\eta_{ig} + \epsilon_{ig},$$

where y^*_{pig} is an unobserved continuous variables, υ is the measurement intercept vector, λ is the vector of factor pattern coefficients, η represents the factor scores, and ϵ is vector of the residuals (Muthén, 1994). Because groups are randomly sampled via cluster or multistage sampling in multilevel settings, parameters of the groups should be modeled as random effects (Muthén, 1994). Thus, in our case, the means of the factor η_{ig} should be modeled as random effects:

$$\eta_{ig} = \alpha + \eta_{B_g} + \eta_{W_{ig}} ,$$

where α is the overall mean, η_{B_g} is the random factor component, which captures the group variation, and $\eta_{W_{ig}}$ is the another random factor component, which captures the variation among individuals within their respective groups (Muthén, 1994). Because η_{ig} includes two random factor components, the total variation of η_{ig} can be decomposed into two components as between group variation, and within group variation:

$$V(\eta_{ig}) = \Psi_T = \Psi_B + \Psi_W ,$$

where Ψ_T represents the total variation for all individuals, Ψ_B represents the between group variation (i.e., variation of means across groups), and Ψ_W represents the within group variations (Muthén, 1994).

The residual variation (ϵ_{ig}) can also be decomposed into two components, between level (Θ_B) and within level (Θ_W) (Muthén, 1994):

$$V(\epsilon_{ig}) = \Theta_B + \Theta_W .$$

Thus, multilevel one factor model can be established as:

$$V\left(y_{pig}^{*}\right) = \Sigma_T = \Sigma_B + \Sigma_W \, .$$

Then, two different models can be defined for between and within levels because variation is decomposed into two non-overlapping pieces. For between:

$$\Sigma_B = \Lambda_B \Psi_B \Lambda_B' + \Theta_B$$

and for within:

$$\Sigma_W = \Lambda_W \Psi_W \Lambda_W' + \Theta_W$$

The estimation of the multilevel SEM models for categorical/ordinal variables is almost the same with the single level robust WLS estimations. Asparouhov and Muthén (2007) explained a three stage estimation procedure for multilevel SEM models for categorical/ordinal variables. In the first stage, p_{th} univariate model parameters are estimated except for off-diagonal elements of Σ_B and Σ_W. In the second stage, bivariate model parameters are estimated by fixing the univariate parameters to their first stage estimates. Then, after computing the asymptotic covariance matrix for the first and second stage estimates, the WLS fit function is minimized to estimate model parameters (Asparouhov & Muthén, 2007).

CHAPTER II

LITERATURE REVIEW

Two previous simulation studies have examined the performance of WLSM for categorical/ordinal data using multilevel models. However, several prior studies have examined the performance of various estimation theories using single-level models. Because prior studies using single-level models may also somewhat inform conclusions about the performance of estimation theories for categorical/ordinal data using multilevel models, both (a) simulation studies examining WLSM estimation with categorical/ordinal data with ***multilevel*** models, and (b) simulation studies examining different estimation theories with categorical/ordinal data with ***single-level*** models, are reviewed here.

Previous Multilevel Model Studies

There are two prior studies about multilevel SEM models for categorical/ordinal variables. The first one by Asparouhov and Muthén (2007), provides the rationale for multilevel SEM models for categorical/ordinal variables. These researchers presented a small simulation example to demonstrate how robust WLS (in their example, the estimator was WLSM) works for categorical/ordinal variables in two-level models. They also compared their results with ML estimators. They simulated data based on the following parameter conditions: Two level CFA models, which included two factors in each level with six dependent variables. Each factor had three dependent variable indicators, and there was no misspecification in their models. Five category ordinal variables were used with thresholds, $\tau p1 = -0.3$, $\tau p2 = 0.4$, $\tau p3 = 1.2$, and $\tau p4 = 1.8$. They generated 100 samples with 100 clusters of size 10 and analyzed the data using both WLSM and ML. The results showed that generally, WLSM performed well in terms of parameter estimates, standard errors of parameter estimates, convergence rate, and Type I error control rate. They concluded that WLSM should be used when categorical/ordinal variables are included in the multilevel SEM models.

The second study, Hsu (2009), examined the sensitivity of fit indices, namely, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standard Root Mean Square Residual Between and Within (SRMR-B and SRMR-W), and Weighted Root Mean Square Residual (WRMR) with dichotomous variables in two-level CFA models by applying WLSM estimator. He created two different two-level CFA population models which included a total of two factors with five indicator variables per factor in both between and within levels. In the first two-level CFA model, factor pattern coefficients were set to 0.8 in both within and between levels. In the second two-level CFA model, while within level factor pattern coefficients were set to 0.8, between level coefficients were set to 0.4 to create two different ICC conditions by these two models. Between and within level factor correlations in both two-level CFA population models were specified as 0.5.

The study included five different design factors: (a) number of clusters (150, 200, and 250), (b) cluster size (15 and 30), (c) intra-class correlation (low=.16 and high=.29), (d) thresholds (two level thresholds for 0-1 binary outcomes with 50%-50% balanced and 75%-25% skewed conditions), and (e) model misspecification (true and misspecified factor structure models). To create misspecified models, he collapsed the two factors into one in the models. Specifically, he created a total of three misspecified factor structures along with true population models: (a) within level misspecification was created by collapsing the two within level factors into one within level factor, (b) between level misspecification was created by collapsing the two between level factors into one between level factor, and (c) within and between level misspecification was created by collapsing two factors into one in both levels simultaneously. Two hundred replications were created for each condition in his simulation study.

Hsu (2009) found that RMSEA and CFI should not be used to detect between level misspecifications because they only provided information about the within level misspecifications. As expected, SRMR-W was sensitive to the within model misspecification. SRMR-B did not work well to reflect the misspecification on the between level with the lower ICC condition. He reported that WRMR was sensitive to detecting both between and within level misspecifications, but WRMR should be used after obtaining correctly specified within level models. He suggested that first RMSEA, CFI, and SRMR-W should be used to correctly specify within level models. After obtaining correctly specified within level models, WRMR can be applied to assess between level model specifications.

Previous Single Level Model Studies

Potthast (1993) examined the WLS estimation technique in CFA models with ordered categorical variables. In her simulation study, a total of four different oblique CFA models were used. The first model included four variables and one factor, the second model had eight variables and two factors, the third model had 12 variables and three factors, and the last model had 16 variables and four factors. In the second, third, and fourth models, each factor had four variables. In the models, population factor pattern coefficients were created as 0.707, and factor correlations were created as 0.3. To examine the effect of nonnormality, five level ordered categorical items were created as four different levels of nonnormality. The baseline case of zero skewness and kurtosis compared three different nonnormal distributions: (a) skewness = 0.19, kurtosis= - 1.12; (b) skewness = 0, kurtosis = 2.79; and (c) skewness = 2.52, kurtosis = 5.80. As the last factor in the simulation, two different sample sizes were used: 500 and 1000. For the each of 32 cells (4 x 4 x 2), 100 replications were run and analyzed by WLS. Results were evaluated based on parameter bias, parameter standard error bias, and chi-square test statistics.

Parameter estimates were not affected by any conditions. The estimated bias was lower than 5% for both pattern coefficients and factor correlations. Negative bias was observed for the pattern coefficient and factor correlation standard errors. The bias increased when model size or kurtosis increased. In terms of model rejection, chi-square test statistics rejected the true models more than was expected for larger models. High kurtosis caused higher rejection rates in large models, but the fit was poor even for zero kurtosis models. Large sample sizes provided more accurate results.

Hutchinson and Olmos (1998) evaluated a total of eight fit indices in CFA models using ordered categorical data. These fit indices were the comparative fit index (CFI; Bentler, 1990), critical N (CN; Hoelter, 1983), incremental fit index (IFI; Bollen, 1989), measure of centrality (MOC; McDonald, 1989), nonnormal fit index (NNFI; Bentler & Bonett, 1980), relative fit index (RFI; Bollen, 1986), and the root mean square error of approximation (RMSEA; Steiger, 1990). Additionally, they investigated the behavior of chi-square test statistics. They manipulated sample size, model size, estimation procedure, and level of nonnormality while evaluating the fit indices.

Two different CFA population models were created: Two and four factor oblique CFA models. Each factor included four categorized ordinal variables. Factor pattern coefficients varied with population values of 0.6, 0.7, and 0.8. The correlation between factors was specified at 0.5. Two different sample sizes were used: 500 and 1000. Categorical/ordinal data were created as five categories. First multivariate normal data were generated; then the data were categorized by using thresholds. Four levels of nonnormality were generated by changing the threshold values. Two input matrices were generated for the each cell of the 16 design conditions (2 x 2 x 4): The covariance matrix based on the Pearson correlations and the correlation matrix based on polychoric correlations. One hundred replications were run for each of the cells in the study. Parameters were estimated by using ML with Pearson correlations or WLS with the polychoric correlation matrix.

Chi-square statistics indicated poor fit when the data were nonnormally distributed, especially with the large model size. Generally, RMSEA performed well. Model size and sample size did not affect RMSEA values. MOC showed poor fit when the larger model was used. The models were favored by RFI and CN when larger sample sizes were used. RFI was also the most affected fit index among all the indices by levels of nonnormality. NNFI, CFI, and IFI were the least affected fit indices across all design variables. The authors suggested using WLS with ordered categorical data when the data are extremely skewed and leptokurtic. They recommended reporting multiple fit indices including RMSEA and NNFI when nonnormal ordered categorical data were analyzed.

DiStefano (2002) examined the effect of categorization on parameter estimates, standard errors and five fit indices (i.e., chi-square GFI, SRMR, NNFI, and RMSEA) in confirmatory factor analysis models. Four different CFA population models were created. Two different sample sizes were used: 350 and 700. Three different data analysis situations were considered in the simulation. As the baseline model, continuous multivariate normal data were generated and analyzed with ML estimation by using a Pearson correlation matrix as input. In the second data analysis situation, ML estimation was applied to the covariance matrix by ignoring the five level categorical/ordinal data. In the last situation, WLS estimation was used with the polychoric correlation matrix. In the CFA models, factor pattern coefficients varied between 0.3 and 0.7. The factor correlation was set to 0.3 in all models. All the population models and their corresponding parameter estimates were specified based on the review of empirical CFA studies published between 1992 and 1999 in *Educational and Psychological Measurement and Psychological Bulletin*.

Ignoring the categorical structure of the ordinal data and applying regular ML estimation caused negatively biased parameter estimates, and the bias level increased when the categorical data followed nonnormal distributions. The bias levels in DiStefano's (2002) study were higher than in previous studies because lower population parameter values were used in the present study. On the other hand, WLS with polychoric correlations showed relatively unbiased parameter estimates. In terms of standard errors, extreme levels of bias were observed with smaller sample size and larger models. Fit indices showed robust behaviors in the majority of the study conditions.

Flora and Curran (2004) examined the performance of WLS and WLSMV with categorical data in CFA models. One major difference in their study was creating nonnormal y* distributions for their items. y* is an unobserved continuous variable that is measured with ordinal or categorical y variables. Most of the simulation studies in categorical/ordinal SEM assumed that the y*s were normally distributed, but Flora and Curran (2004) examined the effect of nonnormality of y* on model estimation results. They created five different y* distributions: normal (skewness = 0, kurtosis = 0), low skewness and low kurtosis (skewness = 0.75, kurtosis = 1.75), low skewness and moderate kurtosis (skewness = 0.75, kurtosis = 3.75, moderate skewness and low kurtosis (skewness = 1.25, kurtosis = 1.75), and moderate skewness and moderate kurtosis (skewness = 1.25, kurtosis = 3.75).

In their simulation study, in addition to distribution characteristics of the y*, they evaluated different sample sizes (100, 200, 500, and 1000), number of categories of items (two categories and five categories), and four different CFA model specification (Model 1: one factor five indicators; Model 2: one factor 10 indicators; Model 3: two correlated factors each measured by five indicators; and Model 4: two correlated factors each measured by 10 indicators). The factor pattern coefficients were set to 0.7, and factor correlation was set to 0.3 in their population models. They ran 500 replications for each of the cells (total of 160 cells = 5 x 4 x 4 x 2). For each replication, both WLS and WLSMV estimations were applied.

Generally, the polychoric correlations were estimated accurately regardless of the distribution characteristics of the latent variables. Only, the modest violation of nonnormality caused a slight bias on the bivariate relations of the latent variables. WLS estimation produced nonconvergent solutions with smaller sample sizes (i.e., 100). WLS also produced nonconvergent solutions when the number of variables (i.e., 20) increased. On the other hand, WLSMV provided proper solutions even with small sample size and complex models. WLS estimation caused positively biased chi-square test statistics and negatively biased standard errors. The biases increased when sample size decreased and model complexity increased. WLSMV provided less biased estimates for the chi-square test statistics and standard errors. There was no severe bias on parameter estimates based on both WLS and WLSMV. They found that nonnormality in the latent response variables slightly increased chi-square test statistics obtained with WLS, but not WLSMV.

Beauducel and Herzberg (2006) compared ML estimation with WLSMV estimation. Correctly specified CFA models were used with one, two, four, and eight factors, and each factor included five variables in the models. A total of five different levels of categorical/ordinal data used: two, three, four, five, and six categories. Four different sample sizes were manipulated: 250, 500, 750, and 1000. When CFA models were orthogonal, pattern coefficients were specified 0.50. When CFA models were oblique, the pattern coefficients were set to 0.55, and correlations between factors were set to 0.33. Results were evaluated in terms of parameter estimates and corresponding standard error bias, and fit indices (chi-square, CFI, TLI, RMSEA, and SRMR).

Results showed that WLSMV estimation performed well across all conditions, so the authors concluded that WLSMV estimation performed well with smaller sample sizes, and WLSMV does not require large sample sizes for the accurate results that are needed for WLS estimation. WLSMV performed better than ML in terms of controlling Type I error rate when small number of categories were used (i.e., two or three categories). The parameter estimates based on WLSMV were closer to population parameters than the ML population estimates. Sample size did not have any effect on parameter estimates across all conditions for both ML and WLSMV results. Standard errors of parameter estimates were smaller in WLSMV than for ML across all categories. When two or three categories were used, CFI, TLI, and RMSEA from WLSMV estimation showed superior model fit than CFI, TLI, and RMSEA from ML estimation. When five or six category items were used, CFI estimates from WLSMV and ML did not differ, but TLI and RMSEA estimates favored the ML estimation. The SRMR estimates based on WLSMV did not work as effectively as CFI, TLI, and RMSEA with two or three categories. The SRMR values based on ML estimation was smaller than WLSMV estimates when two or three categories were used, but they were close to each other when five or six categories were used.

Lei (2009) compared the MLR with WLSMV estimation for ordinal data in CFA models under different levels of misspecification, score skewness, sample size, and model size. In both MLR and WLSMV polychoric correlations were used as inputs. Two different CFA models were defined with different conditions. For the simpler CFA model (six variables - two factors), three levels of categorization x three levels of omitted paths x three levels of sample sizes were manipulated. For the complex model (nine variables - three factors), a three levels of score categorization x two levels of omitted paths x two levels of sample size design was used. Five point symmetrical (standard normal distribution cut points: -1.5, -.5, .5, and 1.5), mildly skewed (standard normal distribution cut points: -0.05, 0.77, 1.34, and 1.88), and moderately (standard normal distribution cut points: 0.67, 1.28, 1.645, and 2.05) skewed distributions were studied. For the model misspecifications, population parameter values for the secondary cross path coefficient, 0.3, were created, but in the model specification they were fixed to zero. The primary factor pattern coefficients were 0.7 and factor correlations were 0.6. For the simpler model, only one secondary cross path coefficient was fixed to zero while two secondary cross path coefficients were fixed to zero in the complex model. Three different sample sizes, 100, 250, and 1000, were considered for the simpler model, and for the complex model two different sample sizes, 250 and 1000, were evaluated.

Overall, parameter estimates were found unbiased for both estimation methods when the models were correctly specified. Both MLR and WLSMV reduced standard error bias compared to the nonrobust versions, but standard error bias was not negligible for moderately skewed variables when a small sample size (i.e., 100) was used. Chi-square test statistics from WLSMV estimation provided better Type I error control rate than chi-square test statistics from MLR. Lei (2009) indicated that both estimations methods worked well under the examined conditions in the simulation study.

Holgado-Tello, Chacón-Moscoso, Barbero-García, and Vila-Abad (2010) examined the advantages of using polychoric correlations rather than Pearson correlations in both exploratory and confirmatory factor analysis with ordinal data. In their simulation study, they generated three samples, each had sample sizes of 1000, with 12 items following a population model with three, four, and five factors, respectively. For their five category items, they created three different distributional characteristics: symmetric, negatively skewed, and positively skewed. One hundred replications were run for each of the simulation conditions. Then, they applied exploratory factor analysis to both Pearson and polychoric correlation matrices with ML estimation. Also, confirmatory factor analysis was run for Pearson correlation matrices with ML estimation and polychoric correlation matrices with WLS estimation.

Results revealed that in all conditions, polychoric correlations were estimated to be higher than Pearson correlations. The gap between Pearson and polychoric correlation increased when the data were asymmetric. The EFA results with polychoric correlations were more accurate than results obtained based on the EFA with Pearson correlations. When CFAs were conducted with polychoric correlations, the chi-square test rejection rate was close to the nominal level, regardless of the number of factors and asymmetric items. Other fit indices, GFI, AGFI, and RMSEA also provided better results when polychoric correlations were analyzed by WLS, but generally, values of these fit indices were within acceptable limits in both conditions (i.e., ML with Pearson correlations, WLS with polychoric correlations).

DiStefano and Morgan (2014) compared diagonal weighted least squares (DWLS) from LISREL, WLSM, and WLSMV from Mplus. In their simulation study, parameters, standard errors of parameters, and model fit were examined by manipulating sample size, distributional form, and number of categories in a confirmatory factor analysis model (i.e., 20 items and four correlated factor). Factor correlations were specified as 0.3 and factor pattern coefficients were specified as 0.7 in the population. The ordered categorical data created four different types of categories: two, three, five, and seven. Three different distributional characteristics were created: extreme (skewness = 3, kurtosis = 7), moderate (skewness = 1.5, kurtosis = 3), and normal (skewness = 0, kurtosis = 0). Three different sample sizes were used: 200, 400, and 800. One thousand replications were run for each of the 108 cells (3 [DWLS, WLSM, WLSMV] x 4 [two, three, five, seven categories] x 3 [extreme, moderate, normal distributions] x 3 [n = 200, 400, 800]) in the design.

Results showed that all three estimation techniques produced accurate parameter estimates for most distributional types regardless of the sample sizes. When five or seven category items were used, WLSM, and WLSMV estimations overestimated the factor correlations. When two or three categories of nonnormal data were used with DWLS, WLSM, and WLSMV, standard errors of factor pattern coefficients and standard errors of factor correlations were severely underestimated. Additionally, WLSM and WLSMV showed the same underestimation problem when seven category data were analyzed. In terms of chi-square test statistics, average values approached well to the degrees of freedom from DWLS estimation across almost all condition, except extreme nonnormality. The average estimates of the chi-square test statistics from WLSM and WLSMV were higher than average chi-square estimates from DWLS when extreme or moderate nonnormality conditions were presented with few categories. WLSMV based chi-square test statistics approached to degrees of freedom (expected value) better than WLSM based chi-square test statistics. Generally, both CFI and RMSEA fit indices performed well across the study conditions. Nonconvergence problems were observed when DWLS estimation was used with moderate distributions, smaller categories, and smaller sample sizes, so WLSM or WLSMV might be used instead of DWLS under such conditions. On the other hand, when nonnormal five or seven category items were analyzed, WLSM and WLSMV showed estimation problems, such as overestimating the factor correlations, so in these cases DWLS might best be chosen as the estimation method.

Bandalos (2014) compared two robust estimation methods, MLR and WLSMV, in terms of parameter estimates, standard error estimates, power, and Type I error control. The manipulated simulation conditions were data asymmetry, model size, model type, number of categories, model misspecification, and sample size. She also included the non-robust version of ML and WLS estimations for comparison purposes.

Two, three, and four categorical/ordinal data were manipulated. Three levels of asymmetric data were used: low (skew = 2.4, kurtosis = 3.8), moderate (skew = 2.7, kurtosis = 5.4), and high (skew = 3.5, kurtosis = 7). Two different model sizes were applied: the simpler model included 12 variables with three factors, and the complex model included 28 variables with seven factors. In both models, one variable from each factor had one secondary pattern coefficient on another factor. Two types of models, one CFA and one structural model, were created for both 12 and 28 variable models. Primary factor pattern coefficients were set to 0.7, and secondary pattern coefficients were set to 0.3. Factor covariance values varied from 0.3 to 0.5. Structural path coefficients were created between 0.15 and 0.25. Two types of misspecifications were applied: Incorrectly setting the secondary pattern coefficients to zero, and incorrectly specifying one single factor instead of correlated two factors. Four different sample sizes were used: 150, 300, 500, and 1000, but for the 28 variable models 500 was the smallest sample size. Five hundred replications were created for each condition. Each replication was analyzed using WLSMV, MLR, ML, and WLS.

Among all the estimation methods, WLSMV provided the most accurate parameter estimates in both correctly and incorrectly specified models. Factor covariances were underestimated by ML and MLR estimations, and overestimated by WLS estimation. Also for the structural path coefficient estimates, WLSMV provided superior results compared to all other estimation methods in the simulation study. WLSMV and MLR performed well in terms of standard error bias. When Type I error rate was the focus, MLR showed greater control than all the other estimation methods. In terms of power, again WLSMV was superior to MLR and other two estimations. Bandalos (2014) found that even though WLSMV can be used specifically with categorical/ordinal data in structural equation models for estimation method, MLR can also be applied to such data as a second estimation method even though MLR was not developed to analyze categorical/ordinal data.

CHAPTER III

METHOD

A Monte Carlo study was conducted to examine the how well robust WLS estimations (i.e., WLSM and WLSMV) work in terms of parameter estimates, and standard error estimates of parameters in multilevel CFA models for categorical/ordinal data with correctly specified models. More importantly, the sensitivity of commonly used fit indices was examined for detecting misspecified models in multilevel CFA models for categorical/ordinal variables under several conditions.

Population Model

In the present simulation study, a two level-two factor CFA model was used as a population model to generate data. Each factor included five primary indicators in both within and between levels. Additionally, both factor I and II in within and between levels had secondary (cross-pattern coefficients) indicators. The primary factor pattern coefficients in within level from factor I (FWI) to y1 through y5 were 0.7, and from factor II (FWII) to y6 through y10 were 0.7. FWI had a secondary pattern coefficient 0.35 with y6, and FWII had a secondary pattern coefficient 0.35 with y5. The correlation between FWI and FWII was 0.5, and the variances of FWI and FWII were 1.

The specified parameter values in the data generation model are commonly used parameter values in the previous simulation studies for categorical/ordinal outcomes in SEM. It is common to set primary factor pattern coefficients to 0.7 (e.g., Bandalos, 2014; DiStefano & Morgan, 2014; Flora & Curran, 2004; Lei, 2009; Potthast, 1993), and factor correlations to 0.5 (e.g., Bandalos, 2014; Hsu, 2009; Hutchinson & Olmos, 1998) in the SEM simulation studies. The choice of the five indicators per latent variable in the population CFA model is also consistent with some of the previous simulation studies (e.g., Beauducel & Herzberg, 2006; Flora & Curran, 2004; Hsu, 2009). Moreover, the five indicators per latent factor are between the minimum number of indicators (i.e., 4.2) and the maximum number of indicators (i.e., 6.9) per latent variable in the psychological assessment literature (DiStefano & Hess, 2005).

The population model for data generation is consistent with the previous simulation studies, but it is still important to know how the population model is similar to models in the applied research literature. In other words, how the specified model in the present simulation study is ecologically valid. In the present study, the specified two factor-10 indicator CFA model seems to be a smaller model compared to the majority of the CFA studies, but it is still present in the applied research studies (e.g., Boduszek, Hyland, Dhingra, & Mallett, 2013; Gottlieb, Cohen, DeMarree, Treloar, & McCarthy, 2013; Kaya et al., 2015; Taylor, 2015). Moreover, there were some studies which have two factors and a smaller number of indicators than 10, such as five indicators (e.g., Allen, Thaler, Barchard, Vertinski, & Mayfield, 2012), six indicators (e.g., Chessa, Di Riso, Delvecchio, Salcuni, & Lis, 2011), seven indicators (e.g., Granero-Gallegos, Baena-Extremera, Gómez-López, & Abraldes, 2014), eight indicators (e.g., Peterman et al., 2014; Wong et al., 2015), and nine indicators (e.g., Zhang, Bi, & Yu, 2010). Thus, the choice of the two factors and five indicators per factor as the population model is at least plausible with respect to ecological validity.

Two different between level population models were created. The first between level population model (see Figure 1) was exactly the same structure as the within model. The second between level population model (see Figure 2) was different from the within level population model in terms of pattern coefficients and residual variances values. The between level pattern coefficients and residual variances were adjusted to evaluate the effect of Intra-Class Correlations (ICC) on model results. Table 1 shows the two level population parameter values.

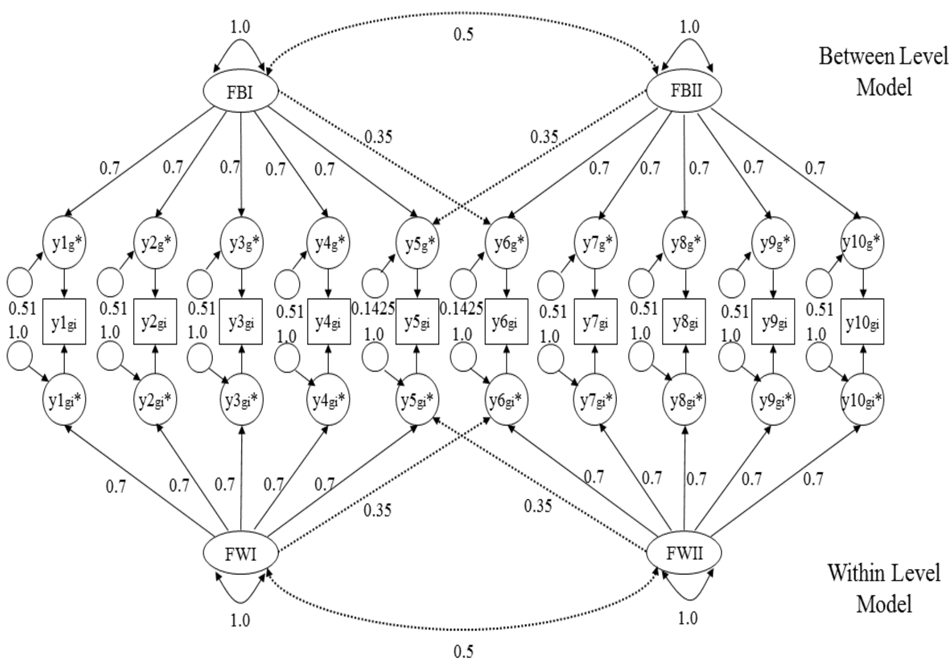

Figure 1. High ICC population model.

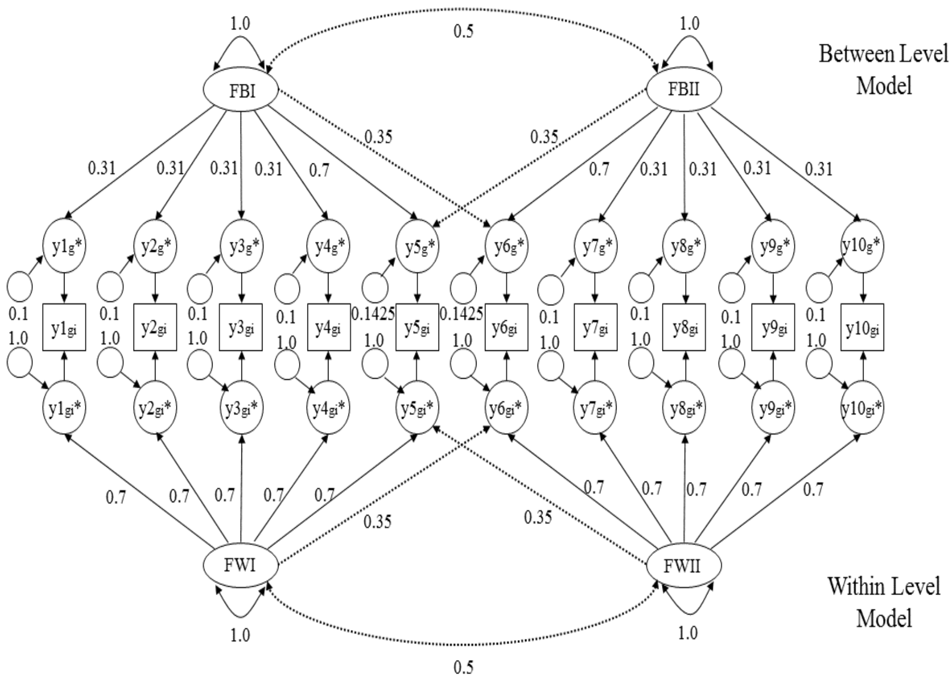

Figure 2. Low ICC population model.

Table 1

Population Parameters for the Data Generations

	Within Level Parameters			Between Level Parameters			
Variables	Factor I	Factor II	Residual Variances	Factor I	Factor II	Residual Variances	ICC
High-ICC Condition							
y_1^*	0.70	0	1	0.70	0	0.51	0.40
y_2^*	0.70	0	1	0.70	0	0.51	0.40
y_3^*	0.70	0	1	0.70	0	0.51	0.40
y_4^*	0.70	0	1	0.70	0	0.51	0.40
y_5^*	0.70	0.35	1	0.70	0.35	0.1425	0.35
y_6^*	0.35	0.70	1	0.35	0.70	0.1425	0.35
y_7^*	0	0.70	1	0	0.70	0.51	0.40
y_8^*	0	0.70	1	0	0.70	0.51	0.40
y_9^*	0	0.70	1	0	0.70	0.51	0.40
y_{10}^*	0	0.70	1	0	0.70	0.51	0.40
Low-ICC Condition							
y_1^*	0.70	0	1	0.31	0	0.10	0.12
y_2^*	0.70	0	1	0.31	0	0.10	0.12
y_3^*	0.70	0	1	0.31	0	0.10	0.12
y_4^*	0.70	0	1	0.31	0	0.10	0.12
y_5^*	0.70	0.35	1	0.70	0.35	0.1425	0.35
y_6^*	0.35	0.70	1	0.35	0.70	0.1425	0.35
y_7^*	0	0.70	1	0	0.31	0.10	0.12
y_8^*	0	0.70	1	0	0.31	0.10	0.12
y_9^*	0	0.70	1	0	0.31	0.10	0.12
y_{10}^*	0	0.70	1	0	0.31	0.10	0.12

Note. ICC = Intra-class correlation.

Design Factors

Misspecification Types

Hu and Bentler (1998, 1999) applied two types of misspecifications in their simulation studies to examine the sensitivity of fit indices in single-level SEM models. Also, Hsu et al. (2015) adopted the same strategies in their simulation study for two-level SEM models for continuous outcomes. The same types of misspecifications were applied in the present study, namely, simple and complex misspecifications. Simple misspecification refers to constraining the modeled factor covariance to zero when the covariance is not zero in the population. Complex misspecification refers to constraining non-zero secondary pattern coefficients to zero when these coefficients are not zero in the population. There were a total of six different misspecification conditions: (a) simple misspecification for the within model (MWs), (b) simple misspecification for the between model (MBs), (c) simple misspecification for both within and between models (MWBs), (d) complex misspecification for the within model (MWc), (e) complex misspecification for the between model (MBc), and (f) complex misspecification for both within and between models (MWBc). Also, the true or correctly specified model was investigated, thus creating a total of seven misspecification conditions.

Intra-Class Correlations (ICC)

ICC is used to quantify the similarity of the individuals within the same group (Muthén & Satorra, 1995). In previous simulation studies on multilevel SEM, the ICC design factor is taken into account by either manipulating the variance of the latent factors in between and within level (e.g., Wu & Kwok, 2012), or manipulating the between level pattern coefficient values while constraining the within level pattern coefficients (e.g., Hsu et al., 2015). For example, Wu and Kwok (2012) created two different ICC conditions in their simulation study by manipulating the variance of the latent factors in between and within levels. For their high ICC condition, they constrained the between and within level factor variances to 1, and this procedure resulted the ICC value of 0.50 (i.e., between factor variance / (between factor variance + within factor variance)). For their low ICC condition (i.e., 0.10), they specified the variance of between level factor as 0.2 and variance of within level factor as 1.8. This approach assumes that measurement invariance holds across the levels (i.e., between and within levels), but this assumption can be easily violated in real data (Muthén, 2008, February 05; Hox, 2008, February 05). Because of the strict assumption of latent factor ICC, Hsu et al. (2015) controlled observed indicator ICC by manipulating the between level factor pattern coefficients. Observed indicator ICC is calculated by dividing the between level indicator variance by the sum of between and within level indicator variances (Hsu et al., 2015).

Similar to observed indicator ICC logic, two different latent indicator ICCs were controlled in the present study: high (0.40) and low (0.12). Latent indicator ICC is the proportion of the between level latent indicator variance to the sum of the between and within level latent indicator variances. The term, latent indicator, refers to the unobserved underlying continuous latent variable (i.e., y*). As explained previously, in multilevel SEM models with categorical/ordinal variables, the underlying continuous latent variables are analyzed rather than observed categorical/ordinal variables

(Asparouhov & Muthén, 2007). In the present simulation study, variances of the between level factors were fixed to 1, so between level variance of the latent indicators, which did not have a secondary factor pattern coefficient, can be computed as the sum of squared between level factor pattern coefficient and residual variance. Factor variances in the within level were also fixed to 1, so similarly within level variances of the latent indicators, which did not have a secondary factor pattern coefficient, can be computed as the sum of squared within level factor pattern coefficient and residual variance. One of the major difference between robust WLS estimations in multilevel SEM models with categorical/ordinal data and ML estimation in multilevel SEM models with continuous data is that residual variances were fixed to 1 in the within level for model identification (Asparouhov & Muthén, 2007). Thus, in the present simulation study, variances of within level latent indicators were equal to squared factor pattern coefficient + 1.

For the high ICC condition, the same between and within level factor structures were specified. In both levels, primary factor pattern coefficients were 0.7, correlations between factors were 0.5, and factor variances were 1. The only difference between and within level for the high ICC condition was the residual variances. Residual variances in the between level were created as 0.51 for the variables, which did not have a secondary factor pattern coefficients. For the other two variables, which had secondary factor pattern coefficients, residual variances were created as 0.1425. In the within level, residuals of all variables were created as 1. Thus, latent indicators ICC, which did not have a secondary factor pattern coefficient, could be calculated as (0.72 + 0.51) / (0.72 + 0.51 + 0.72 + 1) = 0.40.

For the low ICC condition, between level pattern coefficients and residual variances were manipulated while within level pattern coefficients and residual variances were constructed exactly the same as in the high ICC condition. Factor pattern coefficients were fixed to 0.31, and residual variances were fixed to 0.1 to be able to create low latent indicator ICCs. The variables, which had secondary loadings, were not manipulated in terms of their factor pattern coefficients and their residual variances. Based on the manipulated factor pattern coefficients and residual variances, low ICC was calculated as $(0.312 + 0.1) / (0.312 + 0.1 + 0.72 + 1) = 0.12$.

In the population models for data generation, the variables y5* and y6* have secondary factor pattern coefficients in both between and within levels, so calculation of the latent indicator ICCs for these variables are different from other variables, which did not have secondary factor pattern coefficients. The between level variance for a latent indicator, which has a secondary factor pattern coefficient, is calculated as the squared primary factor pattern coefficient + squared secondary pattern coefficient + 2 * primary factor pattern coefficient * factor correlation * secondary factor pattern coefficient + residual variance. Similarly, the within level variance for a latent indicator, which has a secondary factor pattern coefficient, is calculated as the squared primary factor pattern coefficient + squared secondary pattern coefficient + 2 * primary factor pattern coefficient * factor correlation * secondary factor pattern coefficient + 1. The difference between the formulas for between and within level variances for latent indicators is the residual variances. While residual variances can be manipulated in the between level, they are fixed to 1 in the within level. In the present study, latent indicator ICCs for the variables, which had secondary factor pattern coefficients, were fixed to 0.35 in both high and low ICC conditions. In other words, between level factor pattern coefficients and residual variances for the y5* and y6* were not manipulated. Having the same ICC values for those variables across different ICC conditions provided an identical complex misspecification type (i.e., ignoring the secondary factor pattern coefficients) in the present simulation study.

Estimations (EST)

WLSM and WLSMV were used as estimation methods in the present study. Asparouhov and Muthén (2007) and Hsu (2009) only applied WLSM to two level CFA models for categorical/ordinal variables, but as mentioned previously, WLSM and WLSMV differ in terms of their adjustments on chi-square test statistics. Even though the parameter estimates, standard error estimates for parameters are not different, it was expected to have some differences in fit indices because of the different adjustment procedures.

Number of Clusters (NC)

A cluster refers to a group in which individuals tend to show similar characteristics compared to other individuals in different groups. For example, when we collect data from schools using cluster sampling, individuals in the same school are more likely to answer questions in a similar way because of the same environment effect compared to other individuals in different schools (Wu & Kwok, 2012). As mentioned previously, applying conventional statistical methods to analyze clustered data violates the assumption of independence of observations and results in incorrect model results

(Hox, 2002). One of the methods to analyze clustered data is the model-based approach (Wu & Kwok, 2012) and there are only two limited previous studies examining the model-based approach in two-level SEM models with categorical/ordinal data by applying WLSM estimation.

Asparouhov and Muthén (2007) used 100 clusters in their two-level CFA model with two factors and six dependent ordinal variables. Hsu (2009) used cluster sizes of 150, 200, and 250 with 10 binary outcomes with two factors, and each factor had five indicator variables. These two studies did not have any major problems related to model convergence rates. Hsu et al. (2015) applied three different clusters levels (100, 150, and 300), and also mentioned that the number of 50 clusters was not enough for model convergence with ML estimation. In the present study, relatively, a smaller number of clusters were used to evaluate the robust WLS estimations from a different perspective. There was a total of three different numbers of clusters: 30, 50, and 100.

Cluster Size (CS)

Asparouhov and Muthén (2007) used 10 individuals per cluster, and Hsu (2009) used two different cluster sizes: 15 and 30. Hsu et al. (2015) applied four levels of cluster sizes in their simulation study: 10, 20, 30, and 60. In the present study, the three levels of cluster sizes were: 10, 50 and 100.

Number of Categories (CAT)

Asparouhov and Muthén (2007) used five level ordinal data in their simulation study, and Hsu (2009) used two level binary data in his simulation study. To provide more generalizability for the results of the present study, a total of four level categories were used: two, three, five, and seven.

Thresholds (TH)

Asparouhov and Muthén (2007) specified their thresholds as $\tau 1=-0.3$, $\tau 2=0.4$,$\tau 3=1.2$, and $\tau 4=1.8$ to make the five level ordinal variables skewed towards the lower categories, and showed that skewed data towards the lower categories did not cause any problems related to model convergence. They indicated WLSM performed well in terms of parameter estimates, standard errors of parameters, and chi-square test statistics with skewed data. Hsu (2009) used two levels of thresholds with his binary data. He distributed the responses 50% for one category (i.e., 0), 50% for another category (i.e., 1) in his first condition; and he distributed the responses 75% (i.e., 0) for one category, 25% for another category (i.e., 1) in his second condition.

The majority of the simulation studies for single-level categorical/ordinal variables in SEM constructed thresholds based on some specified skewness and kurtosis values, such as skewness = 0, kurtosis = 0. Although researchers specified skewness and kurtosis values to indicate different levels of thresholds for categorical/ordinal data, using skewness and kurtosis with categorical/ordinal variables are unreasonable. Skewness and kurtosis can only be used with continuous data (Thompson, 2006), not with categorical or ordinal data. Thus, instead of using skewness and kurtosis, the percentages of observations in categories were manipulated in the present study.

Two different threshold structures were specified for all levels (i.e., two, three, five, and seven) of categorical/ordinal data. First, similar to one level of the threshold factor in simulation studies by Hutchinson and Olmos (1998), Hsu (2009), and Barendse, Oort, and Timmerman (2015), thresholds were specified to have the same percent of observations in each category for each level of data. The thresholds for this first condition were: $\tau1 = 0$ for two level categorical/ordinal data, $\tau1 = -0.43$ $\tau2 = 0.43$ for three level categorical/ordinal data, $\tau1 = -0.84$ $\tau2 = -0.25$ $\tau3 = 0.25$ $\tau4= 0.84$ for five level categorical/ordinal data, and $\tau1 = -1.07$ $\tau2 = -0.57$ $\tau3 =-0.18$ $\tau4= 0.18$ $\tau5 = 0.57$ $\tau6 = 1.07$ for seven level categorical/ordinal data. Second, thresholds were created based on real data which was taken from a survey called *Student Experience in the Research University* (SERU). The SERU survey has been administered to undergraduate students from 12 major US research universities and is focused on helping improve undergraduate education (see http://seru.tamu.edu/About-SERU). The majority of the responses are on a six point scale (e.g., strongly disagree, somewhat disagree, disagree, somewhat agree, agree, strongly agree). To create skewed data, the items, which have higher numbers of responses in the higher categories (i.e., somewhat agree, agree, strongly agree), were chosen. Next, 158 out of 256 items had a higher number of responses in the higher categories. The number of individuals who responded to these 158 items, varied from 2,000 to 60,000. Percentages were calculated for each category in each item itself. Then, mean, median, standard deviation, maximum, and minimum percentages were calculated for each category for these 158 items. Table 2 illustrates these quantities.

Table 2

Descriptive Statistics of the Each Category for 158 Ordinal Scale Items

Categories	Mean	Median	SD	Minimum	Maximum
Strongly Disagree	2.64%	1.85%	2.42%	0.15%	12.96%
Disagree	5.99%	5.01%	4.19%	0.38%	20.85%
Somewhat Disagree	14.44%	13.71%	7.19%	2.19%	31.60%
Somewhat Agree	27.69%	26.72%	7.17%	8.74%	45.27%
Agree	31.21%	30.98%	8.37%	14.85%	49.49%
Strongly Agree	18.02%	16.18%	9.48%	3.33%	50.12%

Note. SD = Standard deviation.

To specify thresholds for two, three, five, and seven level of data, means of categories in Table 2 were used. For two level categorical data, the first and last three categories were merged. Strongly Disagree with Disagree, Somewhat Disagree with Somewhat Agree, and Agree with Strongly Agree were combined to create three level categorical data. To create five levels of categorical data, the middle two (i.e., Somewhat Disagree and Somewhat Agree) were merged while other categories stayed the same. For the seven level categorical data, the middle two categories were divided into three categories as Somewhat Disagree (10%), Neutral (14%), and Somewhat Agree (18%). All these procedures resulted in thresholds for the two, three, five, and seven categorical data as follows: $\tau1 = -0.74$ for two level categorical/ordinal data, $\tau1 = -1.34$ $\tau2 = 0.02$ for three level categorical/ordinal data, $\tau1 = -1.88$ $\tau2 = -1.34$ $\tau3 = 0.02$ $\tau4= 0.92$ for five level categorical/ordinal data, and $\tau1 = -1.88$ $\tau2 = -1.34$ $\tau3 = -0.88$ $\tau4 = -0.44$ $\tau5 = -0.02$ $\tau6 = 0.92$ for seven level categorical/ordinal data.

Analysis

In the present Monte Carlo study, a total of seven factors were controlled: (a) misspecification types (seven types), (b) ICC (high and low), (c) estimations (WLSM and WLSMV), (d) number of clusters (30, 50, and 100), (e) cluster sizes (10, 50, and 100), (f) number of categories (two, three, five, and seven), and (g) thresholds (two levels: equally sized categories and skewed). One thousand replications were created for each condition, so a total of (7 x 2 x 2 x 3 x 3 x 4 x 2 x 1000) 2,016,000 replications were generated. Replications with convergence problems were excluded from each condition, and new replications were included until one thousand replications were generated. Mplus 7.3 (Muthén & Muthén, 1998-2012) was used to generate and analyze the replications.

Results of the present simulation study were reported first for the correctly specified models (i.e., population models) by providing convergence failures, bias for the parameter estimates, bias for the standard error estimates of the parameters, and performance of the targeted fit indices. Second, performances of the fit indices were provided under the misspecified model conditions.

In the correctly specified models, the formula:

$$Bias\left(\hat{\theta}_i\right) = \sum_{j=1}^{n_T=1000} \left(\frac{\left(\hat{\theta}_{ij} - \theta_i\right)}{\theta_i}\right) / 1000 * 100$$

was used to estimate relative bias for each parameter. In the formula, $\hat{\theta}_{ij}$ represents the *j*th sample estimate of the *i*th population parameter θ_i. Relative biases were estimated for all the parameters in both between- and within-level models separately. Because of the large number of factor pattern coefficients, the relative biases for factor pattern coefficients were averaged in both between- and within-level models. However, there was only one factor correlation in the within-level model, and one factor correlation in the between-level model, so relative bias for the factor correlation was estimated and reported for between-level factor correlation and within level-factor correlation.

Similar to the calculation of the average relative bias for factor pattern coefficients, the relative standard error bias was calculated for the each factor pattern coefficient standard error and averaged in both between- and within-level models separately. For each replication, the empirical standard error (i.e., the standard deviation of the parameter across one thousand replications) was subtracted from the analytical standard error and divided by the empirical standard error. The results across all replications were summed and divided by the number of replications (n=1000). Then, the calculated average relative bias was multiplied by 100 to provide the relative biases in percentages. Standard error bias for factor correlation was estimated separately for the between-level factor correlation standard error and the within-level factor correlation standard error.

Additionally, absolute relative biases were calculated for both parameters and standard error of parameters. The absolute relative bias is calculated differently from the relative bias by taking the absolute value of the difference between parameter estimates and population parameter. Similar to the reporting of average relative bias for factor pattern coefficients, absolute relative bias was reported for factor pattern coefficients in the between- and within level separately by averaging the level specific 12 factor pattern coefficients. Also, similar to the reporting of relative bias for factor correlations, absolute relative bias were calculated and provided for within- and between- level factor correlations separately. Absolute relative biases for standard error of parameters were reported similar to the reporting of the absolute relative bias of the parameters.

The performance of the chi-square test statistics was evaluated by calculating the Type I error rates for the correctly specified model. Also, means and standard deviations of the chi-square statistics were calculated for each design cells in the correctly specified model. The effectiveness of the fit indices (i.e., CFI, TLI, RMSEA, SRMR-W, and SRM-B) was evaluated based on identifying the correctly specified models when Hu and Bentler's (1999) traditional cutoff values (i.e., CFI $\geq$ 0.95, TLI $\geq$ 0.95, RMSEA $\leq$ 0.06, SRMR $\leq$ 0.08) were used. A series of factorial ANOVAs were conducted to determine the effect of design factors on chi-square test statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B.

Similarly, for the misspecified models (i.e., MBc, MWc, MWBc, MBs, MWs, MWBs), the statistical power rates of chi-square test statistics were calculated by specifying $p < 0.05$ statistical significance level. For the fit indices, statistical powers were computed by using traditional cutoff values (i.e., CFI < 0.95, TLI < 0.95, RMSEA > 0.06, SRMR > 0.08). Also, means and standard deviations of chi-square, CFI, TLI, RMSEA, SRMR-W, and SRMR-B were calculated for each design cells, and a series of

ANOVAs were conducted to examine whether fit indices correctly identified the misspecified models regardless of the design factors.

CHAPTER IV

RESULTS

Results were provided under two main headings. In the first one, the correctly specified model was investigated by checking model convergence failure rates, relative bias for parameters, absolute relative bias for parameter, relative bias for standard errors of parameters, absolute relative bias for standard errors of parameters, and behaviors of chi-square, CFI, TLI, RMSEA, SRMR-W, SRMR-B statistics. In the second part, powers of chi-square, CFI, TLI, RMSEA, SRMR-W, and SRMR-B were investigated by considering whether they can detect misspecifications under the six different misspecification conditions.

Correctly Specified Model (True Model)

Convergence Failures

Across all the simulation conditions in the present simulation study, convergence failure percentage for the correctly specified model was 1.214%. The majority of the convergence failures occurred when NC was 30 and CS was 10. Models with the low-ICC conditions had higher convergence failure rates than models with the high-ICC conditions. Generally, models with smaller CAT (e.g., 2 and 3) resulted in more convergence failures than models with higher CAT. Different TH (i.e., balanced and unbalanced threshold structures) structures led to a similar number of convergence failures across all the other conditions. When NC and CS increased, convergence failures decreased. There were not any convergence failures for the models when NC was equal to 100, and CS was equal to 50 and 100. Table 3 shows the convergence failure percentage across all conditions for the correctly specified models. Both WLSM and WLSMV resulted in the same number of convergence failures because of the same procedure being used in the estimation procedure (Muthén et al., 1997). Thus, estimation techniques were not included in Table 3 as a condition for convergence failure rates.

Table 3

Convergence Failure Percentages in the Correctly Specified Model

Number of Clusters	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
NC =30										
	CS=10	Th1	1.9	1.7	1.7	1.4	14.4	12.4	8.7	9.1
		Th2	4.9	1.6	1.6	1.3	16.8	11.4	9.5	8.9
	CS=50	Th1	0.5	0.2	0.3	0.3	1.5	1.0	0.4	0.6
		Th2	0.5	0.1	0.4	0.6	1.6	1.2	0.8	1.1
	CS=100	Th1	0.7	0.3	0.2	0.4	0.6	0.7	0.5	0.5
		Th2	0.4	0.1	0.4	0.4	0.5	0.4	0.5	0.2
NC =50										
	CS=10	Th1	0.2	0.1	0.3	0.1	6.9	5.9	3.1	3.6
		Th2	0.3	0.1	0.2	0.1	8.4	4.7	3.9	3.9
	CS=50	Th1	0	0.1	0	0	0.3	0	0.1	0
		Th2	0	0	0	0	0.2	0	0	0
	CS=100	Th1	0	0	0	0	0	0	0.1	0
		Th2	0	0	0	0	0	0	0	0.1
NC =100										
	CS=10	Th1	0	0	0	0	1.5	0.9	0.5	0.5
		Th2	0	0	0	0	1.5	1.0	0.5	0.5
	CS=50	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
	CS=100	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0

Note. High-ICC = High Intra-Class Correlation; Low-ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Parameter Estimate Bias

Parameter estimate bias was investigated under two subheadings. In the first subheading, relative biases for both between- and within-level model parameters were calculated and examined by considered design factors. In the second heading, absolute relative biases for both between- and within-level model parameters were calculated and examined by considered design factors.

Relative Biases of Parameter Estimates. Biases for the parameter estimates were reported under the two main types of parameters: Factor pattern coefficients and factor correlations. Because of the two-level structure of the model used in the present simulation study, parameter biases were reported for between- and within-level models separately. While biases for factor pattern coefficients were averaged because of the large number of factor pattern coefficients (i.e., 12 factor pattern coefficients in the between-level model and 12 factor pattern coefficients in the within-level model), biases for the factor correlations was not averaged because there was only one estimated factor correlation in the between-level model and one factor correlation in the within-level model. Table 4 illustrates the average relative bias percentages for the factor pattern coefficients and Table 5 demonstrates the relative biases for factor correlation in within- and between-level models across the considered simulation conditions. The estimation techniques (i.e., WLSM and WLSMV) were not included because both WLSM and WLSMV provide identical parameter estimates (Muthén et al., 1997).

Table 4

Average Relative Bias (in %) for Factor Pattern Coefficient Estimates

Number of Clusters	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	4.71	2.72	2.02	1.58	3.86	2.42	1.67	1.28
		Th2	5.75	2.58	1.64	1.48	5.18	2.29	1.26	1.09
	CS=50	Th1	0.85	0.53	0.36	0.36	0.50	0.34	0.40	0.21
		Th2	0.85	0.51	0.36	0.32	0.72	0.31	0.23	0.20
	CS=100	Th1	0.25	0.23	0.20	0.14	0.16	0.06	0.08	0.05
		Th2	0.17	0.06	0.15	0.13	0.27	0.07	0.08	0.07
NC =50										
	CS=10	Th1	2.23	1.37	1.08	0.78	2.29	1.39	0.85	0.76
		Th2	2.80	1.19	0.80	0.71	2.41	1.38	0.88	0.72
	CS=50	Th1	0.48	0.26	0.18	0.18	0.20	0.18	0.10	0.08
		Th2	0.46	0.25	0.19	0.15	0.39	0.14	0.09	0.08
	CS=100	Th1	0.30	0.18	0.13	0.13	0.15	0.10	0.07	0.08
		Th2	0.10	0.07	0.09	0.09	0.16	0.10	0.10	0.09
NC =100										
	CS=10	Th1	1.11	0.79	0.59	0.41	0.88	0.63	0.43	0.35
		Th2	1.32	0.55	0.37	0.35	0.95	0.59	0.38	0.30
	CS=50	Th1	0.29	0.14	0.11	0.10	0.22	0.13	0.08	0.08
		Th2	0.24	0.17	0.11	0.10	0.21	0.09	0.07	0.06
	CS=100	Th1	0.10	0.04	0.04	0.02	0.10	0.04	0.05	0.01
		Th2	0.01	-0.02	0.01	0.01	0.05	0.07	0.07	0.01
Between-Level										
NC =30										
	CS=10	Th1	-1.03	-2.19	-2.99	-3.41	-3.12	-4.41	-5.23	-5.39
		Th2	0.29	-3.08	-3.51	-3.83	-3.76	-5.62	-6.04	-6.00
	CS=50	Th1	-3.59	-4.07	-4.07	-4.18	-4.82	-5.31	-3.94	-4.92
		Th2	-3.57	-4.14	-4.08	-3.96	-4.86	-4.76	-4.89	-4.54
	CS=100	Th1	-2.43	-2.47	-2.41	-2.32	-4.17	-3.64	-3.72	-3.20
		Th2	-2.26	-2.77	-2.53	-2.38	-3.31	-3.53	-3.61	-3.28
NC =50										
	CS=10	Th1	-0.56	-1.46	-1.68	-1.90	-3.81	-3.31	-4.81	-3.66
		Th2	-0.68	-1.63	-1.98	-2.09	-3.44	-3.84	-3.56	-3.85
	CS=50	Th1	-2.12	-2.32	-2.49	-2.44	-2.68	-2.97	-2.70	-2.74
		Th2	-2.12	-2.36	-2.47	-2.48	-2.55	-2.87	-2.81	-2.74
	CS=100	Th1	-1.50	-1.51	-1.53	-1.49	-2.34	-2.16	-2.07	-2.05
		Th2	-1.40	-1.59	-1.57	-1.52	-2.11	-2.20	-2.19	-2.05
NC =100										
	CS=10	Th1	-0.44	-0.80	-0.93	-0.98	-2.45	-1.88	-1.92	-2.08
		Th2	-0.20	-0.78	-1.04	-1.06	-2.74	-1.87	-2.08	-1.93
	CS=50	Th1	-1.06	-1.20	-1.25	-1.27	-1.59	-1.28	-1.26	-1.29
		Th2	-1.06	-1.19	-1.29	-1.29	-1.18	-1.30	-1.31	-1.30
	CS=100	Th1	-0.59	-0.61	-0.58	-0.63	-1.35	-1.28	-1.26	-0.72
		Th2	-0.59	-0.67	-0.65	-0.62	-1.26	-1.31	-1.32	-0.76

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Table 5

Relative Bias (in %) for Factor Correlation Estimates

Number of Clusters	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	1.16	0.24	0.20	0.39	3.83	2.04	1.43	1.77
		Th2	2.42	0.62	0.02	-0.26	2.71	2.67	1.66	1.71
	CS=50	Th1	0.33	-0.20	-0.25	-0.21	0.64	0.33	0.28	0.14
		Th2	0.04	0.15	-0.21	-0.27	0.54	0.41	0.22	0.21
	CS=100	Th1	0.51	0.16	-0.08	-0.01	0.45	0.20	0.10	0.12
		Th2	0.39	0.26	-0.04	-0.08	0.38	0.29	0.14	0.12
NC =50										
	CS=10	Th1	1.86	0.83	0.48	0.44	1.82	1.15	1.12	1.25
		Th2	1.93	0.71	0.04	0.01	2.38	1.19	0.91	1.05
	CS=50	Th1	0.09	-0.05	0.02	-0.01	0.80	0.39	0.28	0.31
		Th2	0.24	0.11	-0.10	-0.09	0.43	0.51	0.37	0.32
	CS=100	Th1	0.01	0.09	-0.01	-0.08	0.42	0.24	0.20	0.24
		Th2	0.39	-0.06	0.05	0.04	0.38	0.30	0.20	0.21
NC =100										
	CS=10	Th1	0.66	0.30	0.26	0.34	0.76	0.31	0.07	0.21
		Th2	1.05	0.40	0.14	0.14	1.08	0.29	0.04	0.08
	CS=50	Th1	0.19	0.19	0.11	0.10	0.19	0.29	0.26	0.29
		Th2	0.08	0.08	0.10	0.03	0.28	0.39	0.34	0.31
	CS=100	Th1	0.17	0.13	0.02	0.05	0.15	0.09	0.07	0.09
		Th2	0.32	0.04	0.14	0.14	0.17	0.07	0.07	0.07
Between-Level										
NC =30										
	CS=10	Th1	6.23	2.62	1.89	1.28	21.22	11.35	15.01	13.81
		Th2	2.29	3.17	1.84	1.15	20.55	11.03	10.28	8.19
	CS=50	Th1	3.38	4.47	4.71	4.96	2.99	2.40	3.00	0.73
		Th2	3.99	4.55	5.05	4.74	4.23	2.39	1.08	0.24
	CS=100	Th1	3.76	4.56	4.23	4.02	3.44	3.06	2.53	2.15
		Th2	4.34	5.13	4.93	4.81	2.24	3.01	2.51	1.76
NC =50										
	CS=10	Th1	2.19	1.92	1.06	0.93	10.71	4.88	4.75	3.95
		Th2	2.36	1.37	0.81	0.54	11.28	6.60	4.16	2.74
	CS=50	Th1	1.04	1.19	1.71	1.69	0.56	0.51	-0.16	-0.44
		Th2	1.55	1.62	1.98	1.94	0.79	0.74	0.19	-0.32
	CS=100	Th1	2.44	2.74	3.29	3.27	1.76	1.86	1.38	1.22
		Th2	2.60	3.29	3.78	3.66	1.48	1.69	1.55	1.16
NC =100										
	CS=10	Th1	1.68	1.34	1.08	0.83	6.45	3.31	2.63	2.42
		Th2	1.49	0.99	0.69	0.66	5.97	3.79	2.62	2.06
	CS=50	Th1	-0.06	0.19	0.41	0.43	0.76	-0.66	-0.75	-0.87
		Th2	0.37	0.30	0.57	0.54	-0.32	-0.42	-0.70	-0.86
	CS=100	Th1	1.48	1.63	1.64	1.93	0.85	0.85	0.67	1.16
		Th2	1.52	1.93	2.13	2.08	0.72	0.83	0.75	1.13

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

The relative biases for the parameter estimates was evaluated based on the previous simulation studies cutoff values: Relative bias under 5% indicated a trivial bias, between 5% and 10% indicated a moderate bias, and greater 10% indicated a substantial bias (DiStefano & Morgan, 2014; Flora & Curran, 2004; Yang-Wallentin, Joreskog, & Luo, 2010). A positive relative bias indicates that parameter is overestimated, and a negative bias indicates that parameter is underestimated.

Average relative biases for the factor pattern coefficients were trivial for the majority of the considered simulation conditions in both between- and within-level models. In the within-level, there were only two conditions resulting in moderate average relative biases (i.e., High-ICC, 2-cat, NC=30, CS=10, Th2; Low-ICC, 2-cat, NC=30, CS=10, Th2). In the between-level, there were five conditions in which moderate average relative biases occurred: low-ICC model when NC=30 and CS=10 with three, five, and seven-level categorical/ordinal data were used. Average relative biases were positive in the within-level model, and negative in the between-level model. This indicated that the pattern coefficients were overestimated in the within-level model, and underestimated in the between-level model.

Generally, in the within-level model, when NC and CS increased, average relative biases for the factor pattern coefficients decreased. Also, average relative biases decreased when CAT increased in data (e.g., seven-level ordinal data produced lower relative bias then five-level ordinal data). The TH structure (i.e., Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure) did not make differences regarding relative biases in the within-level factor pattern coefficients.

There were not obvious patterns for the average relative biases of the factor pattern coefficients in the between-level. Even though the majority of the average relative biases were trivial, there was not a clear direction to say the average relative biases decreased or increased when simulation conditions changed. The only thing that can be concluded about the average relative biases for the factor pattern coefficients in the between-level model was that TH structure did not result in large differences.

The relative biases for the within-level factor correlation were trivial across all design factors. The factorial ANOVA indicated that there were not any noteworthy effects of ICC, CAT, NC, CS, and TH on the relative biases of the within-level correlation (i.e., all η^2 effect sizes were smaller than 1%).

However, substantial biases occurred for the between-level factor correlation for some of the design factors, especially when NC =30 and CS = 10 in the low-ICC condition regardless of the CAT and TH design factors. Substantial biases for the between-level factor correlation also occurred when NC =50 and CS = 10 for the two-level category data in the low-ICC condition. Moderate biases for the between-level factor correlation were observed for the cells: Low-ICC, 2-cat, NC=100, CS=10, Th1 and Th2; Low-ICC, 3-cat, NC=50, CS=10, Th2; and High-ICC, 2-cat, NC=30, CS=10, Th1. Generally, biases of the between-level factor correlation decreased when NC increased. Biases were trivial for most of the conditions under the high-ICC condition, regardless of the design factors, but a few moderate and substantial biases occurred under the low-ICC condition. The factorial ANOVA indicated that there were not any noteworthy effects of ICC, CAT, NC, CS, and TH on the relative bias of the between level correlation (i.e., all η^2 effect sizes were smaller than 1%).

Absolute Relative Biases of Parameter Estimates. In the parameter estimates bias section, relative biases were trivial for almost all of the considered design conditions. However, there might be a situation in which positive and negative relative biases can cancel out each other in a specific cell. If there is a situation that relative biases cancel out each other, absolute values of the relative biases can be taken to determine the magnitude of the bias without cancelling out. Because of this, absolute relative biases were also calculated for factor pattern coefficients and factor correlations. Table 6 provides average absolute relative bias percentages for factor pattern coefficients in both within- and between-level; Table 7 provides absolute relative biases for the within-level factor correlation and the between-level correlation.

Contrary to the findings from the parameter relative bias section, absolute relative biases revealed that parameter estimates were severely biased across the majority of the design cells. Specifically, between-level factor pattern coefficients and correlation were biased in all of the design cells. In the low-ICC condition, absolute biases were higher than in the high-ICC condition for the between-level model parameters. When NC, CS, and CAT design factors increased, absolute relative biases for between-level factor pattern coefficients and correlation was decreased, but the biases were not under moderate bias limit (i.e., 10%). For example, the lowest absolute bias (i.e., 12.4%) for the between-level factor coefficients were calculated when NC and CS were equal to 100 with five- or seven-level CAT in the high-ICC condition.

Absolute relative biases for the within-level parameters were less severe than between-level parameters, but there were still a quite number design cells in which substantial (i.e., more than 10%) or moderate (i.e., between 5% and 10%) absolute biases were calculated. Increasing the NC, CS, and CAT decreased the absolute relative biases for within-level model factor pattern coefficients. Trivial (i.e., less than 5%) biases for the within-level factor pattern coefficients where observed when at least a sample size of 5000 was used: NC=100 and CS=50 or 100; and NC=50 and CS=100.

The lowest absolute relative biases were calculated for the within-level factor correlations compared to all between- and within-level model parameters. Increasing NC, CS, and CAT reduced the absolute biases for the within-level factor correlation. Generally, the within-level factor correlation was unbiased or very close to 5% trivial bias limit when NC was equal to 100 or 50 and CS was equal to 50 or 100. Also, unbiased or very close to 5% trivially biased estimates were observed when NC was equal to 30 and CS was equal to 100 when three, five, or seven level of categorized ordinal data were used. Substantial biases were observed when CS was equal to 10 and NC was equal to 30 or 50 regardless of the other design conditions. Additionally, when NC was equal to 100 and CS was equal to 10, substantial biases were observed for the two level of categorical data (i.e., CAT = two).

Table 6

Average Absolute Relative Bias (in %) for Factor Pattern Coefficient Estimates

Number of Clusters	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	31.03	23.42	19.36	18.09	28.59	21.47	18.60	17.61
		Th2	35.83	22.92	18.07	17.37	32.82	21.71	17.52	16.99
	CS=50	Th1	12.27	9.95	8.55	8.13	10.92	8.92	7.89	7.54
		Th2	13.16	9.54	7.96	7.83	12.04	8.88	7.46	7.28
	CS=100	Th1	9.17	7.36	6.42	6.03	7.79	6.51	5.76	5.49
		Th2	10.05	7.42	5.97	5.82	8.70	6.49	5.50	5.28
NC =50										
	CS=10	Th1	22.80	17.38	14.85	13.81	20.25	15.99	13.80	13.12
		Th2	24.42	17.05	13.69	13.19	22.55	16.10	13.24	12.81
	CS=50	Th1	9.32	7.50	6.46	6.08	8.25	6.80	5.96	5.65
		Th2	9.93	7.27	6.00	5.89	9.22	6.67	5.66	5.51
	CS=100	Th1	6.83	5.54	4.77	4.54	5.92	4.87	4.29	4.12
		Th2	7.36	5.40	4.47	4.34	6.60	4.85	4.11	4.02
NC =100										
	CS=10	Th1	15.36	11.94	10.31	9.63	13.86	11.17	9.67	9.21
		Th2	16.34	11.80	9.50	9.21	15.22	11.12	9.28	8.95
	CS=50	Th1	6.36	5.13	4.41	4.18	5.77	4.70	4.12	3.95
		Th2	6.88	5.04	4.13	4.03	6.38	4.70	3.97	3.84
	CS=100	Th1	4.72	3.81	3.25	3.11	4.12	3.39	2.97	2.81
		Th2	5.07	3.73	3.10	3.01	4.53	3.37	2.85	2.73
Between-Level										
NC =30										
	CS=10	Th1	39.24	35.61	33.81	33.48	67.67	57.43	52.94	53.54
		Th2	42.23	36.19	32.94	33.85	73.27	60.37	54.09	53.74
	CS=50	Th1	27.39	27.02	26.52	26.87	31.61	32.19	28.25	30.30
		Th2	27.78	27.08	26.46	26.04	34.13	30.01	30.30	29.47
	CS=100	Th1	25.18	25.10	25.08	24.87	29.41	28.31	27.94	27.26
		Th2	25.52	25.62	25.26	25.04	28.83	27.65	27.38	26.42
NC =50										
	CS=10	Th1	27.40	24.85	23.32	23.11	47.48	40.24	40.55	36.88
		Th2	28.97	24.68	22.89	22.94	51.19	42.61	37.45	37.68
	CS=50	Th1	19.70	19.11	19.04	18.77	22.33	21.80	21.10	21.00
		Th2	20.00	19.31	18.89	18.88	23.03	21.90	21.02	20.83
	CS=100	Th1	18.65	18.45	18.53	18.56	20.27	19.79	19.44	19.48
		Th2	18.92	18.44	18.44	18.45	20.45	19.74	19.51	19.41
NC =100										
	CS=10	Th1	18.34	16.84	15.99	15.72	30.06	25.27	23.91	23.68
		Th2	19.12	16.85	15.70	15.61	32.91	26.04	23.67	23.03
	CS=50	Th1	13.29	12.95	12.75	12.71	15.07	14.51	14.22	14.15
		Th2	13.53	12.97	12.73	12.70	15.57	14.56	14.18	14.12
	CS=100	Th1	12.67	12.49	12.43	12.40	13.78	13.45	13.27	13.10
		Th2	12.86	12.49	12.41	12.41	13.88	13.44	13.27	13.09

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Table 7

Absolute Relative Bias (in %) for Factor Correlation Estimates

Number of Clusters	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	20.82	17.71	15.84	14.90	18.83	15.72	14.90	14.27
		Th2	23.38	17.16	14.76	14.48	20.49	16.46	14.05	13.63
	CS=50	Th1	9.19	7.57	6.91	6.76	7.94	7.04	5.89	6.09
		Th2	10.03	7.78	6.62	6.62	8.83	6.87	6.12	6.01
	CS=100	Th1	7.22	5.88	5.27	5.19	5.49	4.92	4.43	4.27
		Th2	7.71	5.88	4.99	4.94	6.24	5.02	4.34	3.99
NC =50										
	CS=10	Th1	16.32	12.86	11.68	10.90	14.32	11.77	11.24	10.67
		Th2	17.50	12.92	11.13	10.74	16.21	12.30	10.99	10.59
	CS=50	Th1	7.01	5.85	5.15	4.98	6.28	5.37	4.92	4.67
		Th2	7.43	5.76	4.93	4.86	6.56	5.34	4.74	4.62
	CS=100	Th1	5.19	4.48	3.81	3.75	4.19	3.67	3.35	3.28
		Th2	5.76	4.46	3.74	3.65	4.88	3.64	3.24	3.20
NC =100										
	CS=10	Th1	11.21	8.81	7.87	7.53	10.06	8.39	7.85	7.46
		Th2	12.02	9.15	7.62	7.41	11.70	8.71	7.57	7.40
	CS=50	Th1	4.90	4.13	3.62	3.44	4.23	3.64	3.34	3.22
		Th2	5.15	3.98	3.44	3.38	4.59	3.71	3.31	3.21
	CS=100	Th1	3.58	3.09	2.68	2.69	2.82	2.53	2.32	2.29
		Th2	3.98	3.12	2.63	2.61	3.34	2.45	2.24	2.26
Between-Level										
NC =30										
	CS=10	Th1	41.04	38.31	38.13	38.17	70.18	60.24	58.09	58.05
		Th2	40.59	38.89	37.60	38.05	71.29	62.24	59.07	58.57
	CS=50	Th1	33.77	33.86	34.26	34.44	38.85	37.81	36.39	37.75
		Th2	34.07	34.51	34.80	34.40	38.42	37.92	37.81	37.48
	CS=100	Th1	32.31	33.08	33.73	33.76	35.18	34.70	35.09	35.07
		Th2	32.44	33.08	33.43	33.52	35.45	35.01	34.71	33.84
NC =50										
	CS=10	Th1	29.66	28.54	27.87	27.91	49.07	43.04	42.75	42.89
		Th2	30.07	28.45	27.59	27.52	52.31	44.97	41.30	41.30
	CS=50	Th1	25.76	25.76	25.85	26.06	27.93	27.45	27.28	27.19
		Th2	25.86	26.23	26.12	26.17	28.75	27.62	27.29	27.26
	CS=100	Th1	24.58	24.73	24.98	25.03	26.37	26.04	25.94	25.99
		Th2	24.47	24.53	25.28	25.20	26.61	25.97	26.03	26.02
NC =100										
	CS=10	Th1	19.97	19.35	18.88	18.88	32.91	29.82	28.74	28.42
		Th2	20.51	19.33	18.71	18.75	35.27	30.11	28.39	27.96
	CS=50	Th1	18.25	18.23	18.24	18.33	20.43	19.62	19.30	19.25
		Th2	18.40	18.37	18.24	18.29	20.51	19.79	19.19	19.14
	CS=100	Th1	16.93	17.03	17.19	17.13	17.65	17.46	17.48	17.77
		Th2	16.96	17.03	17.22	17.27	17.86	17.37	17.35	17.63

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Standard Error Bias

Standard error bias was investigated under two subheadings similar to the parameter estimate bias. In the first subheading, relative biases of standard error estimates of both between- and within-level model parameters were calculated and reported by considered design factors. In the second subheading, absolute relative biases of standard error estimates of both between- and within-level model parameters were calculated and reported by considering the simulation design factors.

Relative Biases of Standard Error Estimates. Similar to the reporting relative biases for the parameter estimates, relative biases for standard errors of parameters were reported under the two main types: Relative biases for standard error of factor pattern coefficients, and relative biases for standard error of factor correlations. Table 8 provides the average relative bias percentages for the standard errors of the factor pattern coefficients while Table 9 provides relative bias percentages for the standard errors of the factor correlation in the within- and between-level models across the considered simulation conditions.

Across all design conditions, 50% of the calculated average standard error relative biases for the within-level factor pattern coefficients were substantially biased (i.e., relative bias greater than 10% or less than -10%). Average standard error relative biases for the within-level factor pattern coefficients were smaller in the low-ICC condition than in the high-ICC condition. Generally, average standard error biases for the within-level factor pattern coefficients decreased when NC increased. On the other hand, when CS increased, the average relative biases increased. Similarly, when CAT increased, the average relative bias increased. TH structure did not make greater differences regarding average standard error biases for the within-level factor pattern coefficients. In addition to the provided standard error relative bias percentages for the within-level factor pattern coefficients in Table 8, Figure 3 visually provide these average relative bias percentages for easier understanding of the effect of design factors on the average standard error relative biases. In Figure 3, dashed lines were used to specify -10 % and 10 % substantial relative bias limits.

In terms of average standard error relative biases for the between-level factor pattern coefficients, 43.75 % of them exceeded the substantial relative bias limit across all the design cells. Even though there were no obvious patterns for the biases based on simulation conditions, most of the time, the low-ICC condition provided less biases than the high-ICC condition. When NC increased, the average standard error relative biases for the between-level factor pattern coefficients decreased. When CS increased in the high-ICC condition, the average standard error relative biases for the between-level factor pattern coefficients increased, but in the low-ICC condition, there was no obvious increase or decrease based on the CS changes. The smaller NC (i.e., 30) with smaller CS (i.e., 10) especially produced unstable standard error estimates for the between-level factor pattern coefficients. Generally, TH structure did not show large differences in terms of average standard error relative biases, except for the low-ICC condition when NC=30 and CS=10. Table 8 and Figure 4 illustrate all the average standard error relative biases numerically and visually. In Figure 4, dashed lines were used to specify -10 % and 10 % substantial relative bias limits.

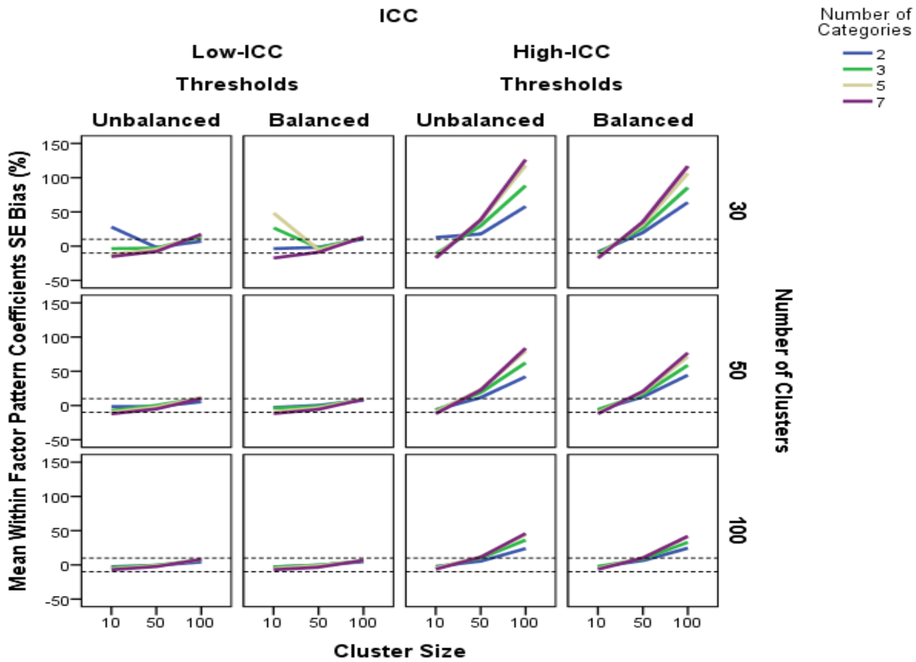

Figure 3. Average standard error relative biases for the within level factor pattern coefficients.

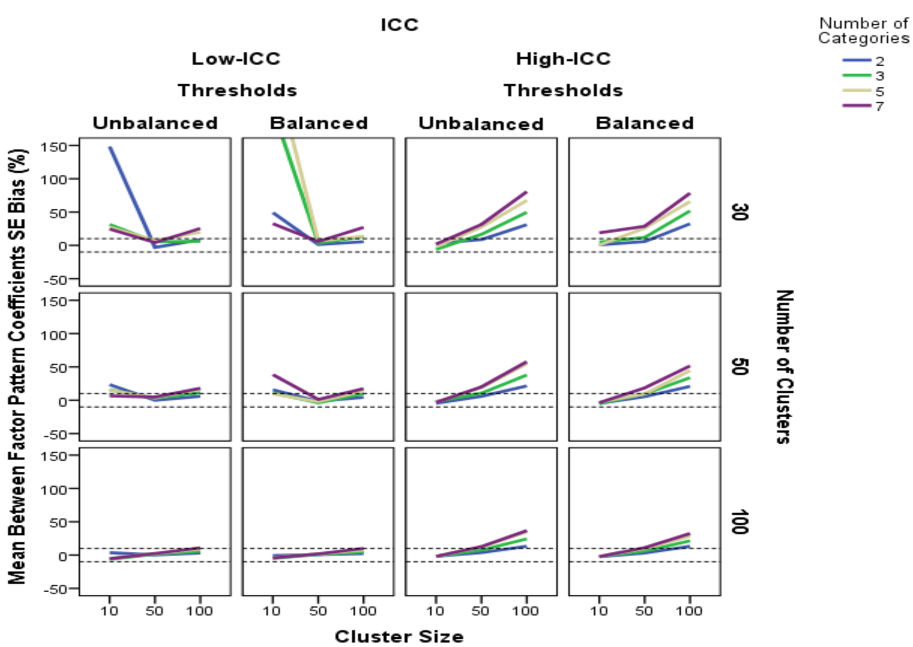

Figure 4. Average standard error relative biases for the between level factor pattern coefficients.

Table 8

Average Relative Bias (in %) for Pattern Coefficient Standard Error Estimates

Number of Clusters	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	-8.71	-10.87	-13.82	-17.49	-3.54	26.67	48.36	-17.34
		Th2	12.83	-11.17	-14.12	-17.16	27.96	-3.45	-12.00	-15.26
	CS=50	Th1	19.83	26.54	31.83	35.64	-1.71	-2.51	-5.37	-8.85
		Th2	17.71	29.83	37.42	38.45	-1.78	-2.74	-4.51	-7.71
	CS=100	Th1	63.86	85.62	106.27	117.01	10.47	12.47	13.01	13.28
		Th2	58.01	88.41	117.81	126.48	7.07	13.64	16.52	17.31
NC =50										
	CS=10	Th1	-6.74	-5.80	-9.77	-12.04	-2.80	-3.75	-8.64	-11.81
		Th2	-6.17	-6.76	-9.25	-11.82	-1.44	-7.11	-9.56	-12.18
	CS=50	Th1	12.64	16.41	19.27	20.72	0.14	-1.39	-3.31	-5.64
		Th2	11.61	18.90	23.32	22.42	-1.57	0.29	-2.06	-5.00
	CS=100	Th1	44.35	58.94	71.34	76.93	7.65	9.65	10.02	9.14
		Th2	42.16	62.38	80.00	83.75	5.56	10.96	11.96	10.29
NC =100										
	CS=10	Th1	-2.88	-2.27	-5.19	-6.49	-2.86	-3.12	-4.99	-7.06
		Th2	-2.28	-4.14	-4.53	-6.26	-2.69	-3.73	-5.77	-7.08
	CS=50	Th1	6.23	8.56	10.79	10.01	-0.29	-0.28	-1.16	-3.40
		Th2	5.41	9.82	11.98	11.31	-0.64	-0.26	-1.09	-2.48
	CS=100	Th1	24.47	32.96	41.22	41.89	4.67	5.98	6.26	6.48
		Th2	23.98	36.38	44.14	45.95	4.22	7.11	7.66	8.15
Between-Level										
NC =30										
	CS=10	Th1	0.79	5.05	0.54	18.82	49.20	204.34	275.77	32.65
		Th2	3.03	-6.12	-1.85	1.84	148.33	31.33	27.23	24.56
	CS=50	Th1	5.68	11.89	25.80	28.70	1.27	3.32	6.55	3.31
		Th2	8.67	16.56	27.57	31.46	-3.09	5.55	7.55	4.27
	CS=100	Th1	32.47	51.79	65.86	78.37	5.61	13.10	13.77	27.03
		Th2	31.04	49.68	67.51	80.64	8.42	6.08	19.62	25.43
NC =50										
	CS=10	Th1	-4.59	-5.21	-2.92	-3.63	15.66	14.90	7.92	38.40
		Th2	-4.48	-1.95	-2.43	-3.23	23.36	15.82	15.13	6.46
	CS=50	Th1	5.37	9.58	9.39	18.53	-1.59	-3.96	-2.09	1.21
		Th2	5.92	10.57	18.79	20.12	-0.07	2.96	3.50	4.75
	CS=100	Th1	20.83	33.88	44.63	51.51	4.42	9.96	13.77	17.38
		Th2	21.44	37.81	54.81	57.88	5.92	11.12	16.97	17.96
NC =100										
	CS=10	Th1	-2.44	-2.19	-1.74	-2.16	-0.85	-4.90	-3.65	-4.23
		Th2	-1.79	-2.00	-1.85	-1.94	3.61	-6.55	-4.77	-5.45
	CS=50	Th1	3.11	5.96	9.63	11.20	0.68	0.86	1.58	1.73
		Th2	3.78	7.46	11.94	12.77	0.18	1.18	2.12	2.34
	CS=100	Th1	13.26	21.40	28.62	32.45	2.35	4.79	7.44	9.99
		Th2	13.19	24.30	34.97	36.80	3.19	5.74	8.80	10.88

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Across all the design conditions, 53.47% of the calculated standard error relative biases for the within-level factor correlation were substantially biased. The standard error relative biases for the within-level factor correlation were more severe in the high-ICC condition. Generally, standard error relative bias decreased when NC increased. CS did not have the same effect on standard error biases for low- and high-ICC conditions. While CS increased in the high-ICC condition, the relative bias increased. However, increasing the CS in the low-ICC condition did not show large differences regarding the standard error relative biases. In the both low- and high-ICC conditions, when CAT increased (i.e., two category through seven category), the standard error relative biases for the within-level factor correlation increased. TH structure did not show large differences in terms of the standard error relative biases for the within-level factor correlation. The relative biases for the within-level factor correlation are shown both numerically and visually in Table 9 and Figure 5. In Figure 5, dashed lines were used to specify -10 % and 10 % substantial relative bias limits.

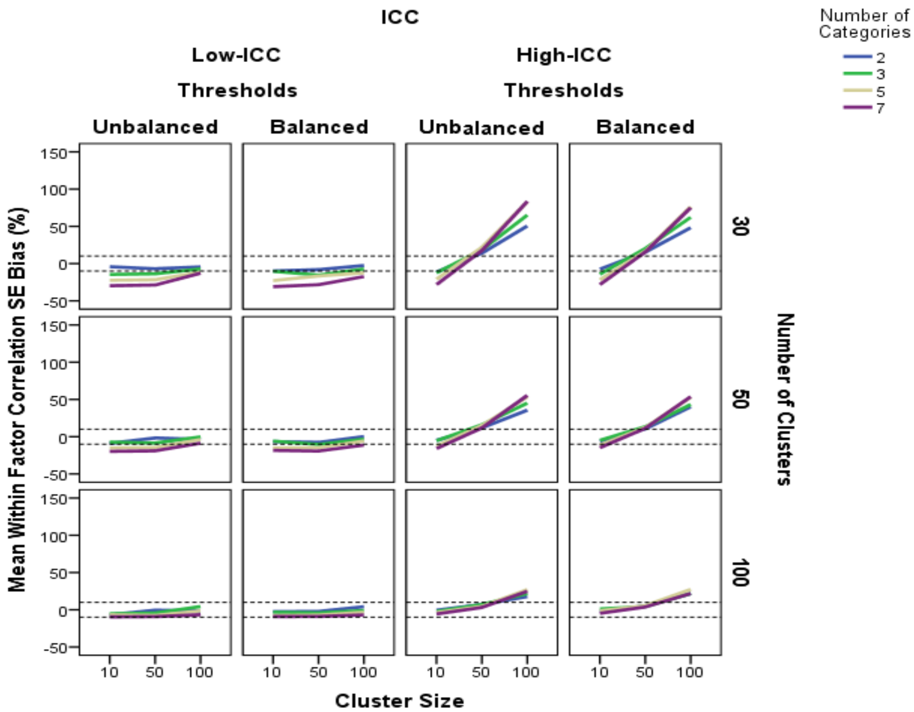

Figure 5. Standard error relative biases for the within level factor correlation.

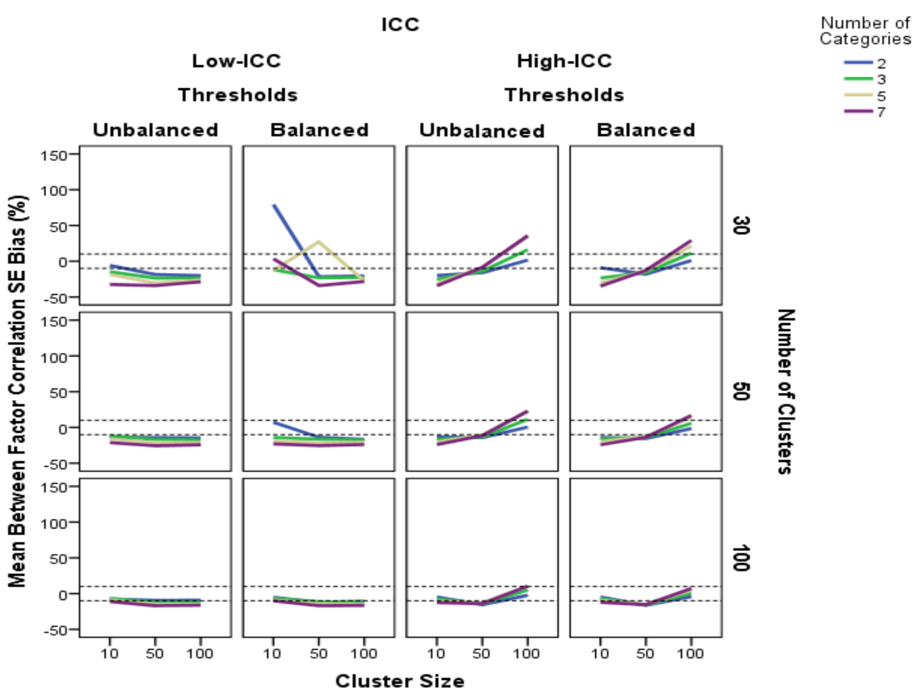

Figure 6. Standard error relative biases for the between level factor correlation.

Table 9

Relative Bias (in %) for Factor Correlation Standard Error Estimates

Number of Clusters	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	-7.41	-14.18	-21.71	-28.25	-9.92	-10.35	-22.85	-30.95
		Th2	-11.32	-12.36	-21.00	-28.21	-4.21	-14.58	-22.42	-29.67
	CS=50	Th1	15.40	20.25	16.71	15.54	-8.12	-15.41	-16.67	-28.36
		Th2	14.05	18.51	-21.98	17.61	-6.96	-13.66	-21.67	-28.80
	CS=100	Th1	48.28	62.18	76.36	75.07	-2.61	-7.17	-12.35	.17.42
		Th2	50.52	65.06	82.92	83.59	-4.34	-7.12	-11.52	-12.84
NC =50										
	CS=10	Th1	-6.20	-4.91	-11.22	-14.87	-6.62	-6.01	-15.27	-18.42
		Th2	-4.91	-5.38	-12.46	-15.86	-9.04	-7.32	-15.28	-19.70
	CS=50	Th1	10.49	13.33	12.33	11.29	-7.58	-10.40	-14.91	-19.24
		Th2	11.86	16.03	14.98	11.77	-1.65	-8.47	-14.78	-18.98
	CS=100	Th1	40.04	43.15	52.83	53.77	0.15	-3.14	-5.73	-11.16
		Th2	35.64	45.05	53.37	55.45	-3.68	-0.36	-3.94	-8.69
NC =100										
	CS=10	Th1	-2.22	1.22	-1.31	-4.82	-2.50	-3.24	-7.74	-9.13
		Th2	-0.54	-2.32	-3.72	-5.68	-6.70	-5.28	-6.75	-9.54
	CS=50	Th1	5.30	4.28	5.53	3.75	-2.19	-4.08	-7.03	-9.04
		Th2	7.15	7.19	4.55	3.13	-0.62	-4.37	-7.51	-9.21
	CS=100	Th1	21.85	21.82	27.35	21.85	4.08	-0.90	-3.30	-6.93
		Th2	17.75	21.58	27.07	24.81	-1.69	4.30	-1.44	-6.57
Between-Level										
NC =30										
	CS=10	Th1	-9.13	-23.42	-30.30	-34.77	79.32	-11.92	-12.88	3.41
		Th2	-19.89	-25.18	-30.85	-34.25	-5.90	-14.85	-18.60	-32.44
	CS=50	Th1	-18.13	-15.79	-13.40	-12.85	-21.57	-23.21	27.05	-34.05
		Th2	-16.09	-13.83	-8.70	-8.47	-18.62	-23.57	-30.52	-34.06
	CS=100	Th1	0.90	11.44	21.42	29.18	-20.54	-22.54	-27.39	-28.35
		Th2	1.72	16.29	34.76	35.83	-20.18	-23.41	-26.51	-28.70
NC =50										
	CS=10	Th1	-13.97	-16.04	-19.98	-24.28	7.34	-13.13	-19.02	-23.02
		Th2	-13.21	-16.51	-20.41	-23.96	-13.55	-11.97	-16.19	-21.18
	CS=50	Th1	-15.53	-14.06	-12.58	-13.85	-13.80	-16.53	-21.54	-25.39
		Th2	-14.20	-13.33	-10.31	-11.44	-14.25	-16.80	-21.37	-25.58
	CS=100	Th1	-1.56	5.70	14.05	16.78	-16.77	-17.78	-20.80	-23.91
		Th2	0.51	11.35	22.44	22.91	-14.73	-17.55	-21.33	-24.26
NC =100										
	CS=10	Th1	-4.78	-6.89	-9.33	-12.20	-5.19	-6.53	-8.80	-10.12
		Th2	-4.67	-7.41	-10.46	-12.66	-7.58	-6.85	-8.78	-11.17
	CS=50	Th1	-16.36	-15.96	-14.87	-15.44	-12.17	-11.38	-14.22	-16.86
		Th2	-15.50	-14.36	-12.88	-13.96	-9.56	-12.06	-14.67	-16.92
	CS=100	Th1	-4.21	0.69	4.63	7.20	-10.65	-11.79	-14.75	-16.52
		Th2	-2.23	5.16	10.38	10.51	-9.24	-11.69	-14.71	-16.17

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

The standard error relative biases were more severe for the between-level factor correlation when compared to standard error relative bias for the within-level factor correlation. Across all design conditions, 79.17 % of the standard error relative biases were substantially biased. There were no clear distinctions among the levels of NC, CS, ICC, and TH. Generally, increasing CAT inflated the standard error relative biases for the between-level factor correlation regardless of the other design factors. In Figure 6 and Table 9, these dynamics are provided both visually and numerically. In Figure 6, dashed lines were used to specify the substantial bias levels, specifically, -10 % and +10 %.

Absolute Relative Biases of Standard Error Estimates. Absolute standard errors biases for the parameters were serious for almost all of the design conditions regardless of the design factors in both within- and between-level modes as shown in Tables 10 and 11. In terms of between-level parameter standard error estimates, all the absolute relative biases were above 10%, which indicated that all standard errors of between-level factor pattern coefficients and correlation were substantially biased. Similarly, for the within-level model standard error estimates of the parameters, substantial biases were calculated for the majority of the design cells. There were some design cells in which moderate absolute biases were observed especially when large sample sizes were used (e.g., NC=100 and CS=50 in the low-ICC condition), but there were not any design cells in which ignorable (i.e., less than 5%) biases were calculated for the standard error estimates of within-level model parameters.

Table 10

Average Absolute Relative Bias (in %) for Pattern Coefficient Standard Error Estimates

Number of Clusters	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	30.15	23.23	21.36	22.76	32.88	57.19	84.21	24.67
		Th2	68.16	21.94	20.40	22.10	76.44	28.93	22.66	24.82
	CS=50	Th1	26.44	31.71	37.00	40.60	14.47	14.98	17.17	19.56
		Th2	25.70	34.46	41.46	43.00	15.34	15.44	17.66	19.72
	CS=100	Th1	65.28	86.49	106.97	117.63	19.79	21.99	24.61	26.72
		Th2	60.01	89.27	118.23	126.97	18.47	23.10	26.99	30.22
NC =50										
	CS=10	Th1	20.58	15.27	15.03	15.86	18.54	14.95	13.59	15.01
		Th2	22.66	15.24	14.19	15.37	25.63	14.44	13.83	15.11
	CS=50	Th1	18.18	21.12	24.03	25.97	10.78	10.72	11.67	13.04
		Th2	18.12	23.10	27.13	27.32	11.07	11.10	11.86	13.21
	CS=100	Th1	45.66	59.80	72.09	77.70	14.79	16.62	18.03	19.13
		Th2	43.78	63.35	80.58	84.44	14.29	17.51	19.24	19.78
NC =100										
	CS=10	Th1	12.71	9.85	9.45	9.78	11.06	9.07	8.86	9.55
		Th2	13.56	10.14	8.74	9.31	12.39	9.32	8.99	9.51
	CS=50	Th1	11.01	12.79	14.94	15.22	7.35	7.35	7.67	8.60
		Th2	11.27	13.82	16.08	16.46	7.56	7.66	8.20	8.72
	CS=100	Th1	26.36	34.57	42.51	43.47	9.78	10.91	11.99	13.24
		Th2	25.82	37.86	45.39	47.34	9.85	11.74	12.90	14.22
Between-Level										
NC =30										
	CS=10	Th1	48.45	52.92	47.03	70.68	107.46	265.76	328.93	86.50
		Th2	51.34	46.16	39.24	48.29	215.71	83.19	79.15	75.21
	CS=50	Th1	32.50	36.93	47.43	52.28	33.86	50.78	34.94	41.22
		Th2	32.18	43.92	44.72	43.40	40.76	37.93	47.65	35.89
	CS=100	Th1	41.99	59.75	71.87	81.52	51.67	48.73	44.58	53.22
		Th2	40.93	59.31	73.16	83.88	43.00	33.47	47.72	41.35
NC =50										
	CS=10	Th1	23.40	20.73	17.30	20.14	63.82	53.41	61.33	82.04
		Th2	29.14	25.01	17.01	20.41	69.91	65.18	66.75	55.01
	CS=50	Th1	19.87	20.93	26.28	26.55	19.23	29.04	25.94	25.37
		Th2	19.39	22.33	26.83	28.03	20.94	32.09	21.97	20.71
	CS=100	Th1	28.50	38.87	48.12	54.41	20.20	22.37	24.28	27.68
		Th2	28.57	42.14	57.48	60.30	19.43	22.86	27.77	27.30
NC =100										
	CS=10	Th1	12.38	11.33	10.97	10.85	33.02	28.24	28.55	33.38
		Th2	13.69	11.42	10.98	11.02	45.69	26.70	31.06	23.89
	CS=50	Th1	11.74	13.32	15.41	16.55	11.83	11.52	11.89	11.96
		Th2	12.34	14.12	17.07	17.74	11.76	11.59	12.11	12.31
	CS=100	Th1	18.53	25.11	31.33	34.79	12.47	13.81	15.50	17.40
		Th2	18.42	27.48	36.97	38.73	12.57	14.34	16.51	18.14

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Table 11

Absolute Relative Bias (in %) for Factor Correlation Standard Error Estimates

Number of Clusters	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
Within-Level										
NC =30										
	CS=10	Th1	13.60	16.62	22.40	28.37	15.34	18.27	26.03	31.09
		Th2	16.41	15.36	21.43	28.29	20.38	17.70	23.47	29.72
	CS=50	Th1	19.93	23.68	23.16	24.18	11.82	16.23	17.50	28.38
		Th2	19.50	23.45	26.82	24.60	11.28	14.82	21.90	28.83
	CS=100	Th1	49.58	62.67	77.07	75.73	10.25	11.69	14.62	18.92
		Th2	51.49	65.61	83.38	84.05	11.09	11.77	14.20	15.88
NC =50										
	CS=10	Th1	10.96	9.94	12.78	15.53	10.93	9.88	15.71	18.69
		Th2	11.61	10.19	13.55	16.41	12.71	10.21	15.69	19.79
	CS=50	Th1	14.33	17.17	16.97	17.66	9.75	11.32	15.05	19.27
		Th2	15.34	19.12	19.19	17.83	7.84	10.12	14.98	19.02
	CS=100	Th1	40.57	43.99	53.24	54.47	7.90	7.73	9.25	12.96
		Th2	36.50	45.62	54.06	56.05	8.52	7.87	8.75	11.23
NC =100										
	CS=10	Th1	7.33	6.63	6.35	7.21	6.74	6.50	8.68	9.72
		Th2	7.69	6.79	6.59	7.57	8.72	7.32	8.09	10.05
	CS=50	Th1	8.70	9.05	10.18	10.57	5.73	5.92	7.71	9.29
		Th2	9.62	10.22	10.30	10.50	5.43	6.19	8.05	9.46
	CS=100	Th1	23.09	23.59	28.71	24.97	6.39	5.23	5.98	7.82
		Th2	19.29	23.62	28.67	27.08	5.72	6.42	5.31	7.62
Between-Level										
NC =30										
	CS=10	Th1	61.80	27.18	31.92	37.05	176.66	56.04	76.19	106.73
		Th2	24.86	28.38	32.41	39.30	78.18	57.66	62.73	50.91
	CS=50	Th1	22.10	21.35	21.47	22.44	26.30	27.71	133.34	37.37
		Th2	21.13	20.40	20.77	21.25	24.52	26.49	31.74	35.15
	CS=100	Th1	19.61	25.27	30.93	36.50	25.22	25.03	28.83	32.55
		Th2	20.18	27.84	41.25	42.70	24.90	25.68	28.05	30.53
NC =50										
	CS=10	Th1	18.34	19.48	21.90	25.60	77.93	26.69	29.26	35.42
		Th2	18.36	20.01	22.47	25.30	37.19	33.64	28.18	28.85
	CS=50	Th1	17.73	17.41	17.12	17.99	18.19	19.29	22.80	26.05
		Th2	17.19	17.27	16.71	17.87	18.27	19.60	22.67	26.29
	CS=100	Th1	15.40	18.08	21.85	24.36	19.31	19.87	21.87	24.66
		Th2	15.35	20.85	28.45	29.06	18.14	19.86	22.58	24.90
NC =100										
	CS=10	Th1	11.22	11.77	12.51	14.21	16.56	15.99	16.71	17.33
		Th2	11.34	12.06	13.22	14.46	17.70	16.51	16.80	17.47
	CS=50	Th1	16.96	16.79	16.16	16.67	14.41	13.76	15.51	17.60
		Th2	16.33	15.60	14.98	15.87	13.10	14.24	15.90	17.67
	CS=100	Th1	11.72	12.34	13.74	15.30	13.12	13.68	15.77	17.20
		Th2	11.70	13.83	16.73	17.26	12.39	13.67	15.71	16.93

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure.

Performance of the Fit Indices on the Correctly Specified Model

In this section, performance of the chi-square statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B were examined when fitting the correctly specified model. First the means and standard deviations of the fit indices were reported (Table 12). Then, a series of factorial ANOVAs were conducted to examine the effect of simulation factors on targeted fit indices. Based on the ANOVA results, means and standard deviations were reported for design factors that accounted for a substantial part of the variation in a particular fit index. Last, Type I error rates for chi-square statistics, and hit rates of CFI, TLI, RMSEA, SRMR-W, and SRMR-B were provided. To calculate the hit rates, Hu and Bentler's (1999) commonly used cutoff values were used.

Table 12
Descriptive Statistics of the Fit Indices for the True Models by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	45.50	22.93	57.18	9.23
CFI	0.998	0.005	0.998	0.007
TLI	1.009	0.021	1.010	0.023
RMSEA	0.003	0.008	0.002	0.006
SRMR-W	0.023	0.016	0.023	0.016
SRMR-B	0.090	0.057	0.090	0.057

Note. n=288,000. Degrees of freedom of the correct model was 64. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

The overall means of the chi-square statistics across all replications were underestimated by both WLSM and WLSMV estimation techniques. The overall mean of the chi-square statistics by WLSM was lower than the overall mean of the chi-square statistics by WLSMV (i.e., 45.50 < 57.18). Ideally, when we correctly specify a model, the estimated chi-square test statistics should approach the model degrees of freedom. In the present simulation study, the degrees of freedom of the correct model was 64, so the expected mean chi-square value across the replications would be around 64 for both WLSM and WLSMV.

The overall means for CFI, TLI, RMSEA, and SRMR-W for both WLSM and WLSMV estimation techniques satisfied the expected conditions based on their critical cutoff values suggested by Hu and Bentler (1999). The expectations for these fit indices are: CFI greater than 0.95; TLI greater than 0.95; RMSEA smaller than 0.06; and SRMR-W smaller than 0.08. On the other hand, the overall means of the SRMR-B across replications in both WLSM and WLSMV were estimated higher than SRMR-B's critical cutoff value, 0.08, so on average, SRMR-B failed to identify correctly specified model based on its critical cutoff value.

Standard deviations are also provided in Table 12. In all fit indices, there were some variations (i.e., *SD* > 0) across the replications, so examining the variations by a series of factorial ANOVAs was worthwhile. Table 13 provides the sum of squares (SOS) and eta square (η^2) effect sizes of each fit index. While SOS was used to show the variability among the replications, η^2 was used to indicate the explained variance by a main effect or an interaction term.

Table 13

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the True Model

	Fit Index					
Sources	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	97808688.85	11.332	139.970	13.096	70.238	946.988
Overal η^2	75.9 %	18.7 %	51.2 %	30.9 %	94.2 %	75.3 %
EST	**10.03%**	0.19%	0.01%	0.30%	0.00%	0.00%
CAT	0.24%	0.15%	1.96%	0.77%	**12.82%**	1.53%
ICC	**11.86%**	0.00%	**8.65%**	0.22%	0.78%	**9.89%**
TH	0.01%	0.00%	0.03%	0.00%	0.01%	0.02%
NC	1.23%	0.92%	**11.64%**	0.42%	**13.74%**	**19.17%**
CS	**30.39%**	**14.39%**	**7.05%**	**24.52%**	**58.06%**	**23.78%**
EST*CAT	0.18%	0.00%	0.01%	0.02%	0.00%	0.00%
EST*ICC	3.43%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	0.56%	0.01%	0.00%	0.04%	0.00%	0.00%
EST*CS	**6.77%**	0.32%	0.00%	0.40%	0.00%	0.00%
CAT*ICC	0.18%	0.05%	0.01%	0.04%	0.15%	0.62%
CAT*TH	0.00%	0.02%	0.06%	0.00%	0.31%	0.06%
CAT*NC	0.03%	0.02%	1.23%	0.24%	0.77%	0.13%
CAT*CS	1.39%	0.14%	0.90%	1.78%	3.71%	1.77%
ICC*TH	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
ICC*NC	0.03%	0.01%	4.43%	0.00%	0.05%	1.31%
ICC*CS	**6.11%**	0.18%	**6.46%**	0.34%	0.08%	**11.18%**
TH*NC	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.01%	0.00%	0.00%	0.02%
NC*CS	0.32%	1.69%	2.80%	0.93%	3.27%	2.95%

Note. n =288,000. Degrees of freedom of the model was 64. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

In Table 13, only main affects and two-way interactions are provided even though full factorial ANOVAs were conducted. The reason why the other three-, four-, five-, and six-way interactions were not included was that these interactions all together explained trivial portions of the sum of squares on the fit indices. These trivial portions were: η^2= 3.14% for chi-square, η^2= 0.61% for CFI, η^2= 5.93% for TLI, η^2= 0.88% for RMSEA, η^2= 0.44% for SRMR-W, and η^2= 2.86% for SRMR-B. The overall η^2 values in Table 13 represent the explained proportions of the corresponding fit indices by all six factors (i.e., estimation, number of categories, intra-class correlation, threshold, number of cluster, and cluster size), and all their possible two-, three-, four-, five-, and six-way interactions.

As shown in Table 13, all the design factors explained substantial proportion of the total SOS for chi-square (i.e., η^2= 75.9%) , TLI (i.e., η^2= 51.2%), SRMR-W (i.e., η^2= 94.2%), and SRMR-B (i.e., η^2= 75.3%). All the design factors accounted for a comparably less proportion of the total SOS of CFI (i.e., η^2= 18.7%) and RMSEA ((i.e., η^2= 30.9%).

Chi-square. The total SOS for chi-square statistics across the all replications of the true model was explained mainly by three main factor and some of their two way interactions. CS, ICC, Est, Est*CS interaction, and ICC*CS interaction accounted for 30.39%, 11.86%, 10.03%, 6.77%, and 6.11% of the total SOS respectively. Means and standard deviations of the chi-square statistics for the true model are provided in Table 14 by the above factors which accounted for a substantial part of the SOS.

Table 14

Mean, Standard Deviation, and Type I Error Rates of Chi-Square Statistics by Estimation, ICC, and CS in the True Model

ICC	Cluster Size	WLSM			WLSMV		
		Mean	SD	Type I	Mean	SD	Type I
High-ICC							
	CS = 10	64.71	14.16	9.56%	64.46	8.69	2.56%
	CS = 50	29.71	12.27	0.03%	50.50	3.82	0.01%
	CS = 100	12.81	7.40	0.00%	47.46	1.74	0.00%
Low-ICC							
	CS = 10	64.38	14.77	10.09%	64.40	8.89	2.73%
	CS = 50	58.12	13.03	3.63%	60.82	7.55	0.63%
	CS = 100	43.30	12.43	0.36%	55.11	5.14	0.04%

Note. n=288,000. Degrees of freedom of the correct model was 64. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size.

In Table 14, Type I error rates are also reported by considering the factors which accounted for a substantial part of the SOS of the chi-square statistics across the replications. Type I error is the probability of erroneously rejecting the null hypothesis when the null hypothesis is true (Thompson, 2006). In the present simulation study, *p* values associated with chi-square test statistics were used to determine the Type I error rates. The most commonly used *p* critical value, 0.05, was appointed to determine the rejection of the model fit. Then, percentages of the replications, which incorrectly rejected the true model, were provided. The overall Type I error rate was 3.95 % when WLSM estimation was used, and 0.99 % when WLSMV estimation was used.

CFI. All design factors and all their possible interactions accounted for 18.7 % of the total SOS (i.e., 11.332) of the CFI (see Table 13). Among all these main and interaction effects, CS accounted for 14.39% of the total SOS. All the others accounted for a negligible part of the SOS of CFI across all replications in the true model. The overall mean of CFI across all replications in the true model was 0.998 with a standard deviation of 0.006. Means and standard deviations of CFI by CS are provided in Table 15.

Table 15
Mean, Standard Deviation, and Hit Rates of CFI by CS in the True Model

Cluster Size	Mean	SD	Hit Rate
10	0.995	0.001	99.24%
50	~1.000	0.001	100%
100	~1.000	~0.000	100%

Note. n = 288,000. Degrees of freedom of the correct model was 64. SD=Standard deviation. ~ means approximately.

In Table 15, hit rates of the CFI are also provided. The term, hit rate, in the present simulation study was considered as the ratio of the replications, which correctly identified the true model, to all replications. Hit rates for the CFI were calculated across the replication by coding 1 if the CFI statistics was greater than its recommended critical value, 0.95, and coded 0 otherwise. Then, this new variable (i.e., hit rate of CFI) was averaged. Because CS accounted for a substantial part of the SOS of the CFI across the replications, the hit rates are provided by CS in Table 15. The overall hit rate of the CFI across all the 288,000 true model replications was 99.75%.

TLI. All the design factors and all their possible interactions accounted for 51.2 % of the total SOS (i.e., 139.97) of the TLI (see Table 13). NC, ICC, and CS main factors accounted for 11.64%, 8.65%, and, 7.05% of the total SOS of the TLI respectively. Also, the two way interaction, ICC*CS, explained 6.46 % of the total SOS. All the other main and interaction effects accounted for a negligible part of the SOS of TLI across all the replications in the true model. The overall mean of the TLI across all replications in the true model was 1.010 with a standard deviation of 0.022. Means and standard deviations of TLI by NC, ICC, and CS are provided in Table 16.

In Table 16, hit rates of the TLI are also provided. Hit rates for the TLI were calculated across the replication by coding 1 if the TLI statistics was greater than its recommended critical value, 0.95, and coded 0 otherwise. Then, this new variable (i.e., hit rate of TLI) was averaged. NC, ICC, CS, and ICC*CS effects accounted for a substantial part of the SOS of the TLI across the replications, the hit rates are provided by NC, CS, and ICC in Table 16. The overall hit rate of the TLI across all the 288,000 true model replications was 99.32%.

Table 16

Mean, Standard Deviation, and Hit Rates of TLI by NC, ICC, and CS in the True Model

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Hit Rate	Mean	SD	Hit Rate
NC=30							
	CS = 10	1.004	0.036	94.59%	1.009	0.040	96.45%
	CS = 50	1.037	0.013	100%	1.004	0.007	99.99%
	CS = 100	1.057	0.020	100%	1.008	0.004	100%
NC=50							
	CS = 10	1.000	0.022	98.00%	1.001	0.021	98.89%
	CS = 50	1.015	0.005	100%	1.002	0.004	100%
	CS = 100	1.022	0.006	100%	1.001	0.002	100%
NC=100							
	CS = 10	0.999	0.011	99.90%	0.999	0.010	99.91%
	CS = 50	1.004	0.002	100%	1.000	0.002	100%
	CS = 100	1.007	0.002	100%	1.001	0.001	100%

Note. n = 288,000. Degrees of freedom of the correct model was 64. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 30.9 % of the total SOS (i.e., 13.096) of the RMSEA (see Table 13). Among all these main and interaction effects, CS accounted for 24.52% of the total SOS. All the others accounted for a negligible part of the SOS of RMSEA across all replications in the true model. The overall mean of the RMSEA across all replications in the true model was 0.003 with a standard deviation of 0.007. Means and standard deviations of the RMSEA by CS are provided in Table 17.

Table 17

Mean, Standard Deviation, and Hit Rates of RMSEA by CS in the True Model

Cluster Size	Mean	SD	Hit Rate
10	0.008	0.010	99.99%
50	0.001	0.002	100%
100	~0.000	0.001	100%

Note. n = 288,000. Degrees of freedom of the correct model was 64. SD=Standard deviation. ~ means approximately.

In Table 17, hit rates of the RMSEA are also provided. Hit rates for the RMSEA were calculated across the replication by coding 1 if the RMSEA statistics was less than its recommended critical value, 0.06, and coded 0 otherwise. Then, this new variable (i.e., hit rate of RMSEA) was averaged. Because CS accounted for a substantial part of the SOS of the RMSEA across the replications, the hit rates are provided by CS in Table 17. The overall hit rate of the RMSEA across the all 288,000 true model replications was 99.99%.

SRMR. In multilevel CFA models, two different SRMRs are calculated, SRMR-W for the within-level structure and SRMR-B for the between-level structure. Because of this difference, SRMR-W and SRMR-B were examined differently. Note that WLSM and WLSMV use the same procedure to calculate the parameter estimates and their standard errors as explained previously. They only differ in terms of chi-square adjustments. Both WLSM and WLSMV estimation techniques provide exactly the same SRMR value for the same data. Thus, estimation technique was not a considered design factor in factorial ANOVAs for both the SRMR-W and the SRMR-B.

SRMR-W. All design factors, except estimation techniques, and all their possible interactions accounted for 94.20 % of the total SOS (i.e., 70.238) of the SRMR-W (see Table 13). CS, NC, and CAT main factors accounted for 58.06%, 13.74%, and, 12.82% of the total SOS of the SRMR-W respectively. All the other main and interaction effects accounted for a negligible part of the SOS of SRMR-W across all the replications in the true model. The overall mean of SRMR-W across all replications in the true model was 0.023 with a standard deviation of 0.016. There were not any substantial interaction effects among the design factors, so the means and standard deviations of SRMR-W are reported for levels of CS, NC, and CAT main effects in Table 18.

In Table 18, hit rates of the SRMR-W are provided. Hit rates for the SRMR-W were calculated across the replication by coding 1 if the SRMR-W statistics was less than its recommended critical value, 0.08, and coded 0 otherwise. Then, this new variable (i.e., hit rate of SRMR-W) was averaged. CS, NC, and CAT effects accounted for a substantial part of the SOS of the SRMR-W across the replications, the hit rates are provided by levels of CS, NC, and CAT main effects in Table 18. The overall hit rate of the SRMR-W across all the 288,000 true model replications was 99.27%.

Table 18

Mean, Standard Deviation, and Hit Rates of SRMR-W by CS, NC, and Number of Categories in the True Model

Factors	Mean	SD	Hit Rate
CS=10	0.040	0.015	97.81%
CS=50	0.017	0.007	100.00%
CS=100	0.013	0.005	100.00%
NC=30	0.031	0.018	97.86%
NC=50	0.023	0.014	99.96%
NC=100	0.016	0.010	100.00%
Cat=2	0.032	0.020	97.10%
Cat=3	0.024	0.014	99.99%
Cat=5	0.019	0.012	100.00%
Cat=7	0.018	0.011	100.00%

Note. n = 288,000. Degrees of freedom of the correct model was 64. CS = Cluster size. NC = Number of cluster. Cat = Number of categories. SD = Standard deviation.

SRMR-B. All design factors and all their possible interactions accounted for 75.30 % of the total SOS (i.e., 979.988) of the SRMR-B (see Table 13). CS, NC, and ICC main factors accounted for 23.78%, 19.17%, and, 9.89% of the total SOS of the SRMR-B respectively. Also, the two way interaction, ICC*CS, accounted for 11.18 % of the total SOS. All the other main and interaction effects accounted for a negligible part of the SOS of SRMR-B across all the replications in the true model. The overall mean of SRMR-B across all replications in the true model was 0.090 with a standard deviation of 0.057. Means and standard deviations of SRMR-B by CS, NC, and ICC are provided in Table 19.

Table 19

Mean, Standard Deviation, and Hit Rates of SRMR-B by ICC, NC, and CS in the True Model

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Hit Rate	Mean	SD	Hit Rate
NC=30							
	CS = 10	0.111	0.024	8.20%	0.246	0.097	0.03%
	CS = 50	0.086	0.018	38.35%	0.105	0.023	12.84%
	CS = 100	0.086	0.018	37.38%	0.093	0.020	27.72%
NC=50							
	CS = 10	0.084	0.017	44.94%	0.169	0.062	0.38%
	CS = 50	0.065	0.012	87.28%	0.078	0.015	57.74%
	CS = 100	0.065	0.013	87.16%	0.070	0.013	78.69%
NC=100							
	CS = 10	0.058	0.011	96.89%	0.108	0.030	13.91%
	CS = 50	0.045	0.008	100.00%	0.054	0.010	98.82%
	CS = 100	0.044	0.008	100.00%	0.048	0.008	99.91%

Note. n = 288,000. Degrees of freedom of the correct model was 64. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

Hit rates of the SRMR-B are provided in Table 19. Hit rates for the SRMR-B were calculated across the replication by coding 1 if the SRMR-B statistics was less than its recommended critical value, 0.08, and coded 0 otherwise. Then, this new variable (i.e., hit rate of SRMR-B) was averaged. CS, NC, and ICC, and ICC*CS effects accounted for a substantial part of the SOS of the SRMR-B across the replications, the hit rates are provided by CS, NC, and ICC in Table 19. The overall hit rate of the SRMR-B across all the 288,000 true model replications was 55.01%.

Misspecified Models

In the present simulation study, there were a total of six misspecification (i.e., MBc, MWc, MWBc, MBs, MWs, MWBs) conditions as explained previously. The performances of the fit indices were examined within each of the misspecification conditions separately. In each misspecification condition, first, overall mean and standard deviations were reported. Second, a series of factorial ANOVAs were conducted to examine the effect of design factors on the targeted fit indices. Based on the ANOVA results, means, standard deviations, and statistical power rates were reported for design factors which substantially accounted for the variation of the targeted fit index. Statistical power rates were calculated based on Hu and Bentler's (1999) recommended cutoff values for the CFI, TLI, RMSEA, SRMR-W, and SRMR-B. Statistical power rates of chi-square test statistics were calculated by specifying $p < 0.05$ statistical significance level.

Performance of the Fit Indices on the Complex Misspecified Between Level Model

Overall mean and standard deviations for chi-square, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation are provided in Table 20. As explained previously, means and standard deviations of SRMR-W and SRMR-B by WLSM and WLSMV were exactly same because of the same procedure used in these estimation techniques to calculate the parameters and standard errors. Another point which should be noted is that the SRMR-W means and standard deviations were exactly the same with the SRMR-W means and standard deviations (see Table 12) from the correctly specified model because the within-level was correctly specified in MBc.

Table 20

Descriptive Statistics of the Fit Indices for the Complex Misspecified Between-Level Model by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	53.08	25.49	62.40	10.92
CFI	0.998	0.007	0.997	0.009
TLI	1.001	0.021	1.006	0.024
RMSEA	0.005	0.008	0.004	0.007
SRMR-W	0.023	0.016	0.023	0.016
SRMR-B	0.107	0.057	0.107	0.057

Note. n=288,000. Degrees of freedom of the MBc was 66. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

In Table 21, main affects and two-way interactions are reported even though full factorial ANOVAs were conducted. Other three-, four-, five-, and six-way interactions explained trivial portions (i.e., η^2= 3.55% for chi-square, η^2= 0.69% for CFI, η^2= 5.56% for TLI, η^2= 0.76% for RMSEA, η^2= 0.44% for SRMR-W, and η^2= 2.62% for SRMR-B) of the SOS on the fit indices. The overall η^2 values in Table 21 represent the explained proportions of the corresponding fit indices by all six factors (i.e., estimation, number of categories, intra-class correlation, thresholds, number of clusters, and cluster size), and their all possible two-, three-, four-, five-, and six-way interactions.

Table 21

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Complex Misspecifed Between-Level Model

	Fit Index					
Sources	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	116960075.60	16.825	145.571	17.371	70.238	944.765
Overal η^2	73.8%	24.4%	52.5%	39.0%	94.2%	70.1%
EST	**5.34%**	0.29%	0.01%	0.46%	0.00%	0.00%
CAT	0.18%	0.27%	0.96%	0.84%	**12.82%**	1.38%
ICC	**11.04%**	0.14%	**6.02%**	0.14%	0.78%	**9.30%**
TH	0.02%	0.00%	0.04%	0.00%	0.01%	0.02%
NC	**6.40%**	0.19%	**11.77%**	0.07%	**13.74%**	**16.46%**
CS	**26.45%**	**20.17%**	**11.31%**	**31.56%**	**58.06%**	**22.08%**
EST*CAT	0.14%	0.00%	0.01%	0.02%	0.00%	0.00%
EST*ICC	2.88%	0.01%	0.00%	0.00%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	1.09%	0.00%	0.01%	0.02%	0.00%	0.00%
EST*CS	**5.40%**	0.44%	0.03%	0.49%	0.00%	0.00%
CAT*ICC	0.25%	0.08%	0.04%	0.03%	0.15%	0.61%
CAT*TH	0.00%	0.02%	0.05%	0.00%	0.31%	0.06%
CAT*NC	0.01%	0.03%	1.11%	0.17%	0.77%	0.14%
CAT*CS	1.79%	0.16%	0.64%	2.25%	3.71%	1.77%
ICC*TH	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
ICC*NC	0.02%	0.01%	4.21%	0.01%	0.05%	1.48%
ICC*CS	**8.64%**	1.26%	**8.37%**	1.93%	0.08%	**10.77%**
TH*NC	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.01%	0.00%	0.00%	0.02%
NC*CS	0.57%	0.64%	2.33%	0.23%	3.27%	3.34%

Note. n =288,000. Degrees of freedom of the model was 66. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

As shown in Table 21, all the design factors explained substantial proportions of the total SOS for chi-square (i.e., η^2= 73.8%) , TLI (i.e., η^2= 52.5%), SRMR-W (i.e., η^2= 94.2%), and SRMR-B (i.e., η^2= 70.1%). All the design factors accounted for a comparably less proportions of the total SOS of CFI (i.e., η^2= 24.4%) and RMSEA (i.e., η^2= 39.0%).

Chi-square. Four main design factors, CS, ICC, NC, EST and two two-way interactions, ICC*CS, EST*CS accounted for a substantial part of the total SOS of chi-square across all the replications in the MBc. The η^2 effect sizes for these CS, ICC, NC, EST, ICC*CS, and EST*CS were 26.45%, 11.04%, 6.40%, 5.34%, 8.645, and 5.40% respectively. Means and standard deviations of the chi-square statistics for the MBc are provided in Table 22 by the above factors which accounted for a substantial part of the SOS.

In Table 22, power rates are also reported by considering the factors which accounted for a substantial part of the SOS of the chi-square statistics across the replications. Power is the probability of rejecting the null hypothesis when the null hypothesis is not true (Thompson, 2006). In the present simulation study, *p* values associated with the chi-square test statistics were used to determine the power rates. The most commonly used *p* critical value, 0.05, was appointed to determine the rejection of the model fit. Then, percentages of the replications, which correctly rejected the MBc, were provided. The overall power rate was 8.94 % when WLSM estimation was used, and 3.26 % when WLSMV estimation was used.

Table 22

Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by Estimation, ICC, NC, and CS in the MBc

ICC	Cluster Size	WLSM			WLSMV		
		Mean	SD	Power	Mean	SD	Power
High-ICC							
NC = 30							
	CS = 10	69.10	15.10	13.05%	67.60	7.80	2.09%
	CS = 50	24.78	10.33	0.00%	52.04	2.85	0.00%
	CS = 100	9.66	5.19	0.00%	49.58	1.58	0.00%
NC = 50							
	CS = 10	72.78	15.67	18.95%	70.08	9.44	5.70%
	CS = 50	34.91	11.90	0.11%	54.03	4.13	0.00%
	CS = 100	15.13	7.03	0.00%	50.26	1.91	0.00%
NC = 100							
	CS = 10	79.39	16.71	31.55%	75.42	11.74	17.25%
	CS = 50	53.21	14.08	2.11%	60.23	6.82	0.41%
	CS = 100	27.75	10.16	0.00%	52.91	2.99	0.00%
Low-ICC							
NC = 30							
	CS = 10	66.02	16.64	11.60%	66.24	8.33	2.05%
	CS = 50	60.18	13.79	3.95%	63.35	6.54	0.24%
	CS = 100	40.85	12.03	0.23%	56.91	4.06	0.00%
NC = 50							
	CS = 10	69.94	15.38	14.84%	68.43	9.24	4.14%
	CS = 50	66.60	14.58	9.76%	66.42	8.32	2.18%
	CS = 100	50.27	12.62	0.74%	59.48	5.30	0.02%
NC = 100							
	CS = 10	72.80	15.54	18.89%	70.80	11.01	9.17%
	CS = 50	76.78	16.14	26.58%	73.40	11.04	13.06%
	CS = 100	65.36	14.57	8.58%	66.02	8.18	2.30%

Note. n=288,000. Degrees of freedom of the MBc was 66. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size.

CFI. All design factors and all their possible interactions accounted for 24.40 % of the total SOS (i.e., 16.825) of the CFI (see Table 21). Among all these main and interaction effects, CS explained 20.17% of the total SOS. All the others accounted for a negligible part of the SOS of CFI across all replications in MBc. The overall mean of CFI across all replications in the MBc was 0.997 with a standard deviation of 0.008. Means and standard deviations of the CFI by CS are provided in Table 23.

Table 23
Means, Standard Deviations, and Power Rates of CFI by CS in the MBc

Cluster Size	Mean	SD	Power
10	0.992	0.012	1.20%
50	0.999	0.002	0.00%
100	~1.000	~0.000	0.00%

Note. n = 288,000. Degrees of freedom of the MBc was 66. SD=Standard deviation. ~ means approximately.

Power rates of the CFI are also provided in Table 23 when the between-level model was complex misspecified. Power rates for the CFI were calculated as dividing the number of replications which correctly detected the misspecification in the model by the total number of replications in a specific design cell. Power rates for the CFI were calculated across the replications by coding 1 if the CFI statistics was less than its recommended critical value, 0.95, and coded 0 otherwise. Then, this new variable (i.e., power rate of CFI) was averaged. Because CS accounted for a substantial part of the

SOS of the CFI across the replications, the power rates are provided by CS in Table 23. The overall power rate of the CFI across all the 288,000 MBc replications was 0.40%.

TLI. All the design factors and all their possible interactions accounted for 52.5 % of the total SOS (i.e., 145.571) of the TLI (see Table 21). NC, CS, and ICC main factors accounted for 11.77%, 11.31%, and, 6.02% of the total SOS of the TLI respectively. Also, the two way interaction, ICC*CS, accounted for 8.37 % of the total SOS. All the other main and interaction effects accounted for a negligible part of the SOS of TLI across all the replications in the MBc. The overall mean of the TLI across all replications in the MBc was 1.007 with a standard deviation of 0.023. Means and standard deviations of the TLI by NC, CS, and ICC are provided in Table 24.

Power rates of the TLI are also listed in Table 24. Power rates for the TLI were calculated across the replication by coding 1 if the TLI statistics was less than its recommended critical value, 0.95, and coded 0 otherwise. Then, this new variable (i.e., power rate of TLI) was averaged. NC, ICC, CS, and ICC*CS effects accounted for a substantial part of the SOS of the TLI across the replications, so the power rates are provided by NC, CS, and ICC in Table 24. The overall power rate of the TLI across all the 288,000 MBc replications was 1.00%.

Table 24

Means, Standard Deviations, and Power Rates of TLI by ICC, NC, and CS in the MBc

Number of Clusters	Cluster Size	High-ICC Mean	High-ICC SD	High-ICC Power	Low-ICC Mean	Low-ICC SD	Low-ICC Power
NC=30							
	CS = 10	0.997	0.036	7.36%	1.007	0.039	3.73%
	CS = 50	1.034	0.013	0.00%	1.003	0.007	0.01%
	CS = 100	1.056	0.019	0.00%	1.007	0.004	0.00%
NC=50							
	CS = 10	0.992	0.023	4.08%	0.998	0.021	1.63%
	CS = 50	1.012	0.005	0.00%	1.000	0.004	0.00%
	CS = 100	1.021	0.006	0.00%	1.002	0.002	0.00%
NC=100							
	CS = 10	0.991	0.013	0.91%	0.996	0.011	0.19%
	CS = 50	1.002	0.003	0.00%	0.999	0.003	0.00%
	CS = 100	1.005	0.002	0.00%	1.001	0.001	0.00%

Note. n = 288,000. Degrees of freedom of the MBc was 66. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 39.0 % of the total SOS (i.e., 17.371) of the RMSEA (see Table 21). Among all these main and interaction effects, CS explained 31.56% of the total SOS. All the others accounted for a negligible portion of the SOS of RMSEA across all replications in the MBc. The overall mean of the RMSEA across all the replications in the MBc was 0.004 with a standard deviation of 0.008. Means and standard deviations of the RMSEA by CS are provided in Table 25.

Table 25

Mean, Standard Deviation, and Power Rates of RMSEA by CS in the MBc

Cluster Size	Mean	SD	Power
10	0.010	0.011	0.004%
50	0.002	0.003	0.00%
100	~0.000	0.001	0.00%

Note. n = 288,000. Degrees of freedom of the MBc was 66. SD=Standard deviation.

In Table 25, power rates of the RMSEA are also provided. Power rates for the RMSEA were calculated across the replication by coding 1 if the RMSEA statistics was greater than its recommended critical value, 0.06, and coded 0 otherwise. Then, this new variable (i.e., power of RMSEA) was averaged. Because CS accounted for a substantial part of the SOS of the RMSEA across the replications, the power rates are provided by CS in Table 25. The overall hit rate of the RMSEA across all the 288,000 MBc replications was 0.001%.

SRMR. SRMR-W was not explored under MBc because SRMR-W is sensitive to within level specification. Only, the SRMR-B was explored under MBc.

SRMR-B. All design factors and all their possible interactions accounted for 70.10 % of the total SOS (i.e., 944.765) of the SRMR-B (see Table 21). CS, NC, and ICC main factors accounted for 22.08%, 16.46%, and, 9.30% of the total SOS of the SRMR-B respectively. Also, the two way interaction, ICC*CS, explained 10.77 % of the total SOS. All the other main and interaction effects accounted for a negligible part of the SOS of SRMR-B across all the replications in the MBc. The overall mean of SRMR-B across all replications in the MBc was 0.107 with a standard deviation of 0.057.

Means and standard deviations of SRMR-B by CS, NC, and ICC are provided in Table 26.

Table 26
Mean, Standard Deviation, and Power Rates of SRMR-B by ICC, NC, and CS in the MBc

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Hit Rate	Mean	SD	Hit Rate
NC=30							
	CS = 10	0.126	0.028	96.94%	0.260	0.099	100.00%
	CS = 50	0.101	0.023	83.06%	0.119	0.027	94.90%
	CS = 100	0.102	0.023	84.90%	0.108	0.024	89.07%
NC=50							
	CS = 10	0.100	0.021	82.81%	0.183	0.064	99.96%
	CS = 50	0.083	0.017	51.59%	0.095	0.019	76.76%
	CS = 100	0.083	0.017	51.41%	0.087	0.017	63.12%
NC=100							
	CS = 10	0.077	0.014	37.21%	0.123	0.032	96.11%
	CS = 50	0.067	0.013	14.38%	0.074	0.014	31.45%
	CS = 100	0.066	0.012	11.64%	0.069	0.012	17.30%

Note. n = 288,000. Degrees of freedom of the MBc was 66. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

Power rates of the SRMR-B are provided in Table 26. Power rates for the SRMR-B were calculated across all the replications by coding 1 if SRMR-B statistics was greater than its recommended critical value, 0.08, and coded 0 otherwise. Then, this new variable (i.e., power rate of SRMR-B) was averaged. CS, NC, and ICC, and

ICC*CS effects accounted for a substantial part of the SOS of the SRMR-B across the replications, the power rates are provided by CS, NC, and ICC in Table 26. The overall power rate of the SRMR-B across all the 288,000 MBc replications was 65.70%.

Performance of the Fit Indices on the Complex Misspecified Within-Level Model

Overall means and standard deviations of chi-square, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation are provided in Table 27. Note that the SRMR-B means and standard deviations were exactly same with the means and standard deviations (see Table 12) from the correctly specified model because the between level was correctly specified in MWc.

Table 27
Descriptive Statistics of the Fit Indices for the Complex Misspecified Within Level Model by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	151.71	126.80	113.46	71.55
CFI	0.985	0.013	0.980	0.018
TLI	0.984	0.026	0.979	0.032
RMSEA	0.019	0.014	0.014	0.011
SRMR-W	0.041	0.012	0.041	0.012
SRMR-B	0.090	0.057	0.090	0.057

Note. n=288,000. Degrees of freedom of the MWc was 66. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

A series of full factorial ANOVAs were conducted to examine the effect of design factors on fit indices. Even though full factorial ANOVAs were conducted, main affects and two-way interactions are reported in Table 28. Other three-, four-, five-, and six-way interactions explained trivial portions (i.e., η^2= 7.30% for chi-square, η^2= 1.11% for CFI, η^2= 3.14% for TLI, η^2= 1.97% for RMSEA, η^2= 1.16% for SRMR-W, and η^2= 2.86% for SRMR-B) of the sum of squares on the fit indices. The overall η^2 values in Table 28 represent the explained proportions of the corresponding fit indices by all six factors (i.e., estimation, number of categories, intra-class correlation, threshold, number of cluster, and cluster size), and all their possible two-, three-, four-, five-, and six-way interactions.

As shown in Table 28, all the design factors explained substantial proportions of the total SOS for chi-square (i.e., η^2= 91.70%) , TLI (i.e., η^2= 53.40%), RMSEA (i.e., η^2= 70.10%), SRMR-W (i.e., η^2= 81.3%), and SRMR-B (i.e., η^2= 75.3%). All the design factors accounted for a comparably less proportion of the total SOS of CFI (i.e., η^2= 41.7%).

Table 28

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Complex Misspecifed Within-Level Model

	Fit Index					
Sources	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	3157707322.75	73.659	253.336	46.762	40.110	946.988
Overal η^2	91.70%	41.70%	53.40%	70.10%	81.30%	75.3 %
EST	3.33%	1.86%	0.94%	3.91%	0.00%	0.00%
CAT	4.16%	0.49%	1.30%	**9.39%**	**9.70%**	1.53%
ICC	**15.14%**	**7.29%**	**9.84%**	**14.24%**	0.92%	**9.89%**
TH	0.00%	0.01%	0.03%	0.00%	0.02%	0.02%
NC	**27.83%**	4.97%	**11.17%**	**6.88%**	**13.96%**	**19.17%**
CS	**6.23%**	**16.28%**	**13.04%**	**19.76%**	**40.19%**	**23.78%**
EST*CAT	0.51%	0.01%	0.01%	0.29%	0.00%	0.00%
EST*ICC	1.13%	0.13%	0.08%	0.26%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	2.04%	0.24%	0.15%	0.01%	0.00%	0.00%
EST*CS	0.81%	0.77%	0.37%	0.08%	0.00%	0.00%
CAT*ICC	1.34%	0.04%	0.01%	0.65%	0.19%	0.62%
CAT*TH	0.05%	0.00%	0.04%	0.10%	0.29%	0.06%
CAT*NC	2.03%	0.01%	0.44%	0.03%	1.19%	0.13%
CAT*CS	0.31%	1.52%	1.87%	4.47%	**8.21%**	1.77%
ICC*TH	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
ICC*NC	3.70%	0.15%	1.68%	0.34%	0.07%	1.31%
ICC*CS	**8.12%**	**5.11%**	**6.95%**	**6.48%**	0.21%	**11.18%**
TH*NC	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
NC*CS	**7.67%**	1.72%	2.35%	1.24%	**5.17%**	2.95%

Note. n =288,000. Degrees of freedom of the MWc was 66. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

Chi-square. Three main design factors, NC, ICC, CS and two two-way interactions, ICC*CS, NC*CS accounted for a substantial part of the total SOS of the chi-square across all the replications in the MWc. The η^2 effect sizes for these NC, ICC, CS, ICC*CS, and NC*CS were 27.83%, 15.14%, 6.23%, 8.12%, 7.67 respectively. Means and standard deviations of the chi-square statistics for the MWc are provided in Table 29 by the above factors which accounted for substantial part of the SOS.

Table 29

Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by Estimation, ICC, NC, and CS in the MWc

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Power	Mean	SD	Power
NC = 30							
	CS = 10	80.08	18.79	29.58%	79.53	20.98	30.41%
	CS = 50	54.59	12.55	1.05%	115.09	36.68	79.00%
	CS = 100	39.41	15.98	0.01%	100.97	30.93	61.64%
NC = 50							
	CS = 10	89.98	23.28	49.92%	91.75	24.06	53.26%
	CS = 50	82.60	18.90	32.84%	170.08	59.04	97.73%
	CS = 100	59.22	12.06	2.09%	173.07	63.89	99.04%
NC = 100							
	CS = 10	114.65	32.83	79.94%	117.82	33.46	82.84%
	CS = 50	170.80	55.85	99.45%	317.86	114.22	100.00%
	CS = 100	135.26	45.56	93.51%	393.79	153.64	100.00%

Note. n=288,000. Degrees of freedom of the MWc was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size. SD = Standard deviation.

In Table 29, power rates are also reported by considering the factors which accounted for substantial part of the SOS of the chi-square statistics across the replications. The overall power rate across all the 288,000 MWc replications was 60.68%.

CFI. All the design factors and all their possible interactions accounted for 41.70 % of the total SOS (i.e., 73.659) of the CFI (see Table 28). Among all these main and interaction effects, CS explained 16.28%, ICC explained 7.29%, and ICC*CS explained 5.11% of the total SOS. All the others accounted for a negligible portion of the SOS of the CFI across all the replications in the MWc. The overall mean of CFI across all replications in the MWc was 0.983 with a standard deviation of 0.016. Means and standard deviations of CFI by ICC and CS are provided in Table 30. Power rates of CFI are also provided by ICC and CS in Table 30.

Table 30

Mean, Standard Deviation, and Power Rates of CFI by ICC and CS in the MWc

	High-ICC			Low-ICC		
	Mean	SD	Power	Mean	SD	Power
CS=10	0.974	0.022	11.83%	0.975	0.020	9.71%
CS=50	0.992	0.009	0.01%	0.977	0.010	0.83%
CS=100	0.997	0.005	0.00%	0.984	0.007	0.002%

Note. n = 288,000. Degrees of freedom of the MWc was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

TLI. All design factors and all their possible interactions accounted for 53.40% of the total SOS (i.e., 253.336) of the TLI (see Table 28). CS, NC, and ICC main factors accounted for 13.04%, 11.17%, and, 9.84% of the total SOS of the TLI respectively. Also, the two way interaction, ICC*CS, accounted for 6.95 % of the total SOS. The overall mean of the TLI across all replications in the MWc was 0.982 with a standard deviation of 0.030. Means and standard deviations of TLI by CS, NC and ICC are provided in Table 31. Power rates were also calculated based on TLI < 0.95 critical value and they are provided in Table 31. The overall power rate of the TLI was 9.57%.

Table 31
Mean, Standard Deviation, and Power Rates of TLI by ICC, NC, and CS in the MWc

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Power	Mean	SD	Power
NC=30							
	CS = 10	0.970	0.045	27.99%	.9782	0.048	23.75%
	CS = 50	1.016	0.015	0.01%	.9753	0.013	4.03%
	CS = 100	1.042	0.020	0.00%	.9872	0.008	0.06%
NC=50							
	CS = 10	0.967	0.031	25.59%	.9677	0.030	23.39%
	CS = 50	0.991	0.009	0.04%	.9683	0.012	6.84%
	CS = 100	1.005	0.007	0.00%	.9783	0.007	0.21%
NC=100							
	CS = 10	0.964	0.021	22.06%	0.9647	0.019	20.20%
	CS = 50	0.977	0.007	0.38%	0.9618	0.012	16.49%
	CS = 100	0.987	0.004	0.00%	0.9698	0.007	1.27%

Note. n = 288,000. Degrees of freedom of the MWc was 66. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 70.10 % of the total SOS (i.e., 46.76) of the RMSEA (see Table 28). CS, ICC, CAT, NC main effects, and ICC*CS two way interactions accounted for 19.76%, 14.24%, 9.39%, 6.88%, and 6.48% of the total SOS of the RMSEA respectively. The overall mean of the RMSEA across all replications in the MWc was 0.017 with a standard deviation of 0.013.

There were no interactions which included CAT or NC factors, so the means and standard deviations for the levels of these factors can be reported and interpreted. The means and standard deviations for the levels of CAT main effect were 0.011 with a standard deviation of 0.009 for 2 level data, 0.016 with a standard deviation of 0.011 for 3 level data, 0.020 with a standard deviation of 0.013 for 5 level data, and 0.021 with a standard deviation of 0.014 for 7 level data. The means and standard deviations for the levels of NC main effect were 0.013 with a standard deviation of 0.014 for NC=30, 0.017 with a standard deviation of 0.013 for NC=50, and 0.021 with standard deviation of 0.009 for NC=100.

Power rates for the levels of CAT and NC were also calculated based on the RMSEA > 0.06 cutoff value. Power rates of the levels of CAT were 0.004% for 2 level data, 0.03% for 3 level data, 0.25% for 5 level data, and 0.58% for 7 level data. Similarly, power rates for the levels of NC were 0.53% for NC=30, 0.12% for NC=50, and 0.002% for NC=100. For the two way interaction of ICC*CS, means standard deviations, and power rates are provided in Table 32.

Table 32
Mean, Standard Deviation, and Power Rates of RMSEA by ICC and CS in the MWc

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.024	.014	0.57%	0.024	0.014	0.72%
CS=50	0.009	.008	0.00%	0.024	0.008	0.00%
CS=100	0.004	.005	0.00%	0.017	0.007	0.00%

Note. n = 288,000. Degrees of freedom of the MWc was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

SRMR. SRMR-B was not explored under MWc because SRMR-B is sensitive to between level specifications. Only, the SRMR-W was explored under MWc.

SRMR-W. All design factors and all their possible interactions accounted for 81.30 % of the total SOS (i.e., 40.11) of the SRMR-W (see Table 28). CS, NC, and CAT main factors accounted for 40.19%, 13.96%, and, 9.70% of the total SOS of the SRMR-W respectively. Also, CAT*CS accounted for 8.21%, and NC*CS accounted for 5.17% of the total SOS in MWc replications. The overall mean of SRMR-W across all replications in the MWc was 0.041 with a standard deviation of 0.012. Means, standard deviations, and power rates of SRMR-W by CS, NC, and ICC are provided in Table 33.

Table 33

Mean, Standard Deviation, and Power Rates of SRMR-W by CS, NC, and CAT in the MWc

		2-Cat		3-Cat		5-Cat		7-Cat	
NC	CS	Mean (SD)	Power	Mean (SD)	Power	Mean (SD)	Power	Mean (SD)	Power
30									
	10	0.081(0.013)	51.35%	0.062(0.009)	2.93%	0.053(0.008)	0.20%	0.051(0.007)	0.05%
	50	0.045(0.006)	0.00%	0.040(0.005)	0.00%	0.038(0.005)	0.00%	0.038(0.005)	0.00%
	100	0.040(0.005)	0.00%	0.038(0.004)	0.00%	0.037(0.004)	0.00%	0.038(0.004)	0.00%
50									
	10	0.065(0.010)	7.12%	0.051(0.007)	0.00%	0.045(0.006)	0.00%	0.044(0.006)	0.00%
	50	0.039(0.005)	0.00%	0.036(0.004)	0.00%	0.035(0.003)	0.00%	0.034(0.003)	0.00%
	100	0.036(0.004)	0.00%	0.035(0.003)	0.00%	0.035(0.003)	0.00%	0.035(0.003)	0.00%
100									
	10	0.050(0.007)	0.00%	0.042(0.005)	0.00%	0.038(0.005)	0.00%	0.037(0.005)	0.00%
	50	0.035(0.003)	0.00%	0.033(0.003)	0.00%	0.032(0.002)	0.00%	0.032(0.002)	0.00%
	100	0.033(0.003)	0.00%	0.033(0.002)	0.00%	0.033(0.002)	0.00%	0.033(0.002)	0.00%

Note. n = 288,000. Degrees of freedom of the MWc was 66. CS = Cluster size. NC = Number of clusters. Cat = Number of categories. SD = Standard deviation.

Performance of the Fit Indices on the Complex Misspecified Between- and Within-Level Model

Overall means and standard deviations of the chi-square statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation are provided in Table 34. In this part, both within and between levels were complex misspecified. SRMR-B is sensitive to between level specifications, and SRMR-W is sensitive to within level specifications, so in Table 34, the mean and standard deviation of the SRMR-B was exactly equal to the mean and standard deviation of the SRMR-B from the MBc (see Table 20), and the mean and standard deviation of the SRMR-W was exactly equal to the mean and standard deviation of the SRMR-W from the MWc (see Table 27).

Table 34

Descriptive Statistics of the Fit Indices for the Complex Misspecified Between- and Within-Level Models by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	159.92	130.69	118.41	73.25
CFI	0.984	0.014	0.979	0.019
TLI	0.983	0.026	0.977	0.033
RMSEA	0.020	0.014	0.015	0.011
SRMR-W	0.041	0.012	0.041	0.012
SRMR-B	0.107	0.057	0.107	0.057

Note. n=288,000. Degrees of freedom of the MWBc was 68. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

A series of full factorial ANOVAs were conducted to examine the effect of design factors on the fit indices. In Table 35, main affects and their two-way interactions are reported. Other three-, four-, five-, and six-way interactions explained trivial portions (i.e., η^2= 7.35% for chi-square, η^2= 1.11% for CFI, η^2= 3.04% for TLI, η^2= 1.99% for RMSEA, η^2= 1.16% for SRMR-W, and η^2= 2.62% for SRMR-B) of the SOS on the fit indices. The ANOVA results for SRMR-W and SRMR-B were also reported but the ANOVA results for SRMR-B were exactly same with the ANOVA results from the MBc, and the ANOVA results for SRMR-W were exactly same with the ANOVA results from the MWc because of the same misspecification. The overall η^2 values in Table 35 represented the explained proportions of the corresponding fit indices by all six factors and all their possible two-, three-, four-, five-, and six-way interactions.

Table 35

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Complex Misspecifed Between- and Within-Level Model

	Fit Index					
Sources	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	3356229567.46	83.970	255.700	47.890	40.110	944.765
Overal η^2	92.10%	45.10%	55.50%	73.00%	81.30%	70.1%
EST	3.70%	1.86%	1.03%	4.25%	0.00%	0.00%
CAT	3.93%	0.20%	0.70%	**8.56%**	**9.70%**	1.38%
ICC	**14.49%**	**5.23%**	**7.79%**	**12.30%**	0.92%	**9.30%**
TH	0.00%	0.01%	0.03%	0.00%	0.02%	0.02%
NC	**29.25%**	**5.45%**	**11.20%**	**7.11%**	**13.96%**	**16.46%**
CS	**5.95%**	**20.72%**	**16.93%**	**23.96%**	**40.19%**	**22.08%**
EST*CAT	0.51%	0.00%	0.00%	0.28%	0.00%	0.00%
EST*ICC	1.10%	0.08%	0.05%	0.23%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	2.17%	0.26%	0.17%	0.01%	0.00%	0.00%
EST*CS	0.83%	0.89%	0.46%	0.11%	0.00%	0.00%
CAT*ICC	1.31%	0.06%	0.03%	0.68%	0.19%	0.61%
CAT*TH	0.05%	0.00%	0.03%	0.10%	0.29%	0.06%
CAT*NC	1.94%	0.03%	0.41%	0.02%	1.19%	0.14%
CAT*CS	0.26%	1.28%	1.54%	4.37%	**8.21%**	1.77%
ICC*TH	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
ICC*NC	3.48%	0.15%	1.71%	0.38%	0.07%	1.48%
ICC*CS	**8.34%**	**6.40%**	**8.23%**	**7.50%**	0.21%	**10.77%**
TH*NC	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
NC*CS	**7.44%**	1.37%	2.13%	1.15%	**5.17%**	3.34%

Note. n =288,000. Degrees of freedom of the MWc was 68. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

As shown in Table 35, all the design factors explained substantial proportions of the total SOS for the chi-square statistics (i.e., η^2= 92.10%), TLI (i.e., η^2= 55.50%), RMSEA (i.e., η^2= 73.00%), SRMR-W (i.e., η^2= 81.3%), and SRMR-B (i.e., η^2= 70.10%). All the design factors accounted for comparably a less proportion of the total SOS of CFI (i.e., η^2= 45.10%).

Chi-square. Three main design factors, NC, ICC, CS and two two-way interactions, ICC*CS, NC*CS accounted for substantial part of the total SOS of chi-square across the all replications in the MWBc. The η^2 effect sizes for these NC, ICC, CS, ICC*CS, and NC*CS were 29.25%, 14.49%, 5.95%, 8.34%, 7.44% respectively. Means and standard deviations of the chi-square statistics for the MWBc are provided in Table 36 by the above factors which accounted for a substantial part of the SOS.

Calculation of the power rates of the chi-square test statistics was conducted similar to the calculation of the power rates in the previous model misspecifications. In Table 36, power rates are reported by considering the factors which accounted for a substantial part of the SOS of the chi-square statistics across the replications in MWBc. The overall power rate of the WLSM estimation was 69.29%, and the overall power rates of WLSMV estimation was 56.85%.

Table 36
Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by Estimation, ICC, NC, and CS in the MWBc

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Power	Mean	SD	Power
NC = 30							
	CS = 10	84.52	19.31	33.76%	82.97	21.61	32.52%
	CS = 50	57.58	12.76	1.29%	119.40	37.49	80.71%
	CS = 100	41.38	16.24	0.01%	104.59	31.64	63.30%
NC = 50							
	CS = 10	96.66	24.28	58.05%	96.12	24.64	56.90%
	CS = 50	87.81	19.69	38.35%	177.08	60.34	98.51%
	CS = 100	62.32	12.16	2.47%	178.97	65.45	99.24%
NC = 100							
	CS = 10	127.10	35.00	88.33%	124.49	34.30	86.33%
	CS = 50	182.85	58.26	99.87%	332.31	116.51	100.00%
	CS = 100	142.45	47.43	95.61%	406.38	157.03	100.00%

Note. n=288,000. Degrees of freedom of the MWBc was 68. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size. SD = Standard deviation.

CFI. All design factors and all possible interactions accounted for 45.10 % of the total SOS (i.e., 83.97) of the CFI (see Table 35). Among all these main and interaction effects, CS accounted for 20.72%, NC accounted for 5.45%, ICC accounted for 5.23%, and ICC*CS accounted for 6.40% of the total SOS. The overall mean of CFI across all replications in the MWBc was 0.981 with a standard deviation of 0.017. Means and standard deviations of CFI by ICC, NC, and CS are provided in Table 37. Power rates of CFI are also provided by ICC, NC, and CS in Table 37.

Table 37

Mean, Standard Deviation, and Power Rates of CFI by ICC, NC, and CS in the MWBc

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Power	Mean	SD	Power
NC = 30							
	CS = 10	0.970	0.028	20.01%	0.976	0.025	14.78%
	CS = 50	0.999	0.003	0.00%	0.981	0.010	0.65%
	CS = 100	~1.000	0.000	0.00%	0.990	0.006	0.00%
NC = 50							
	CS = 10	0.969	0.022	16.95%	0.973	0.020	12.11%
	CS = 50	0.992	0.006	0.01%	0.976	0.009	0.91%
	CS = 100	0.999	0.002	0.00%	0.984	0.005	0.01%
NC = 100							
	CS = 10	0.968	0.016	13.66%	0.972	0.014	7.62%
	CS = 50	0.981	0.005	0.04%	0.971	0.009	1.83%
	CS = 100	0.989	0.003	0.00%	0.977	0.005	0.01%

Note. n=288,000. Degrees of freedom of the MWBc was 68. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size. SD = Standard deviation. ~ means approximately.

TLI. All design factors and all possible interactions accounted for 55.50% of the total SOS (i.e., 255.7) of the TLI (see Table 35). CS, NC, and ICC main factors accounted for 16.93%, 11.20%, and, 7.79% of the total SOS of the TLI respectively. Also, the two way interaction, ICC*CS, accounted for 8.23 % of the total SOS. The overall mean of TLI across all replications in the MWBc was 0.980 with a standard deviation of 0.030. Means and standard deviations of TLI by CS, NC and ICC are provided in Table 38. Power rates were also calculated based on TLI < 0.95 critical value and are provided in Table 38. The overall power rate of the TLI was 6.33% by WLSM and 15.99 by WLSMV estimations.

Table 38

Mean, Standard Deviation, and Power Rates of TLI by ICC, NC, and CS in the MWBc

Number of Clusters	Cluster Size	High-ICC Mean	High-ICC SD	High-ICC Power	Low-ICC Mean	Low-ICC SD	Low-ICC Power
NC=30							
	CS = 10	0.964	0.044	31.89%	.976	0.046	25.24%
	CS = 50	1.014	0.015	0.03%	.975	0.013	4.01%
	CS = 100	1.041	0.019	0.00%	.987	0.008	0.06%
NC=50							
	CS = 10	0.960	0.031	32.29%	.965	0.029	25.47%
	CS = 50	0.990	0.009	0.08%	.968	0.011	6.94%
	CS = 100	1.004	0.007	0.00%	.978	0.007	0.21%
NC=100							
	CS = 10	0.957	0.022	32.54%	.962	0.019	22.71%
	CS = 50	0.975	0.007	0.61%	.962	0.011	17.60%
	CS = 100	0.986	0.004	0.00%	.970	0.007	1.21%

Note. n = 288,000. Degrees of freedom of the MWBc was 68. High ICC = High intra-class correlation. Low-ICC = Low intra-class correlation. NC = Number of cluster. CS = Cluster size. SD = Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 73.0 % of the total SOS (i.e., 47.89) of the RMSEA (see Table 31). CS, ICC, CAT, NC main effects, and ICC*CS two way interactions accounted for 23.96%, 12.30%, 8.56%, 7.11%, and 8.23% of the total SOS of RMSEA respectively. The overall mean of RMSEA across all replications in the MWBc was 0.018 with a standard deviation of 0.013.

For simplicity, the means, standard deviations, and power rates of RMSEA for the levels of main factors of CAT and NC were reported without considering any other design factor because there were no interactions which included these main factors. The means and standard deviations of the levels of CAT main effect were 0.012 with a standard deviation of 0.009 for 2 level data, 0.017 with a standard deviation of 0.011 for 3 level data, 0.020 with a standard deviation of 0.014 for 5 level data, and 0.022 with a standard deviation of 0.015 for 7 level data. The means and standard deviations for the levels of NC main effect were 0.014 with a standard deviation of 0.015 for NC=30, 0.017 with a standard deviation of 0.013 for NC=50, and 0.022 with a standard deviation of 0.009 for NC=100.

Power rates for the levels of CAT and NC were also calculated based on the RMSEA > 0.06 cutoff value. Power rates of the levels of CAT were 0.01% for 2 level data, 0.04% for 3 level data, 0.28% for 5 level data, and 0.62% for 7 level data. Similarly, power rates for the levels of NC were 0.57% for NC=30, 0.13% for NC=50, and 0.003% for NC=100. For the two way interaction of ICC*CS, means standard deviations, and power rates are provided in Table 39.

Table 39

Mean, Standard Deviation, and Power Rates of RMSEA by ICC and CS in the MWBc

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.026	0.013	0.65%	0.025	0.014	0.75%
CS=50	0.009	0.008	0.00%	0.024	0.008	0.00%
CS=100	0.004	0.005	0.00%	0.017	0.007	0.00%

Note. n = 288,000. Degrees of freedom of the MWBc was 68. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

SRMR. Both SRMR-W and SRMR-B were not examined under MWBc condition because SRMR-W was already explored under MWc, and SRMR-B was already explored under MBc.

Performance of the Fit Indices on the Simple Misspecified Between-Level Model

Overall means and standard deviations for the chi-square statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation method are provided in Table 40. Note that the SRMR-W mean and standard deviation were exactly same with the mean and standard deviation (see Table 12) from the correctly specified model because the within level was correctly specified in MBs. Thus, SRMR-W was not explored in this section.

Table 40

Descriptive Statistics of the Fit Indices for the Simple Misspecified Between-Level Model by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	91.11	52.09	79.86	25.98
CFI	0.990	0.017	0.987	0.021
TLI	0.992	0.030	0.989	0.036
RMSEA	0.013	0.014	0.009	0.010
SRMR-W	0.023	0.016	0.023	0.016
SRMR-B	0.178	0.061	0.178	0.061

Note. n=288,000. Degrees of freedom of the MBs was 65. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

In Table 41, η^2 effect size values are reported for the main and two-way interaction effects even though full factorial ANOVAs were conducted on fit indices. Other three-, four-, five-, and six-way interactions accounted for trivial portions (i.e., η^2= 4.76% for chi-square, η^2= 1.12% for CFI, η^2= 2.79% for TLI, η^2= 1.01% for RMSEA, η^2= 0.44% for SRMR-W, and η^2= 2.84% for SRMR-B) of the sum of squares on the fit indices. The overall η^2 values in Table 41 represent the explained proportions of the corresponding fit indices by all six factors (i.e., estimation, number of categories, intra-class correlation, threshold, number of cluster, and cluster size), and all their possible two-, three-, four-, five-, and six-way interactions.

As shown in Table 41, all the design factors and their interactions accounted for substantial proportions of the total SOS for chi-square (i.e., η^2= 62.90%) , TLI (i.e., η^2= 51.20%), RMSEA ((i.e., η^2= 57.60%), SRMR-W (i.e., η^2= 94.2%), and SRMR-B (i.e., η^2= 51.30%). For CFI, all the design factors accounted for comparably a less proportion of the total SOS (i.e., η^2= 45.60%).

Table 41

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Simple Misspecifed Between-Level Model

	Fit Index					
Sources	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	497033658.37	104.097	316.811	44.896	70.238	1081.867
Overal η^2	62.90%	45.60%	51.20%	57.60%	94.2%	51.30%
EST	1.83%	0.42%	0.21%	2.11%	0.00%	0.00%
CAT	0.01%	2.16%	0.67%	0.36%	**12.82%**	0.98%
ICC	2.50%	2.71%	0.06%	0.03%	0.78%	**6.43%**
TH	0.03%	0.01%	0.04%	0.02%	0.01%	0.01%
NC	**31.77%**	1.61%	**8.05%**	**5.16%**	**13.74%**	**10.56%**
CS	3.51%	**26.17%**	**21.47%**	**35.15%**	**58.06%**	**15.35%**
EST*CAT	0.00%	0.02%	0.01%	0.02%	0.00%	0.00%
EST*ICC	0.39%	0.03%	0.02%	0.00%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	3.28%	0.02%	0.03%	0.05%	0.00%	0.00%
EST*CS	0.41%	0.39%	0.23%	0.68%	0.00%	0.00%
CAT*ICC	0.37%	0.48%	0.70%	0.13%	0.15%	0.47%
CAT*TH	0.00%	0.02%	0.00%	0.01%	0.31%	0.04%
CAT*NC	0.01%	0.22%	0.57%	0.05%	0.77%	0.13%
CAT*CS	1.30%	0.32%	0.14%	2.09%	3.71%	1.28%
ICC*TH	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%
ICC*NC	0.03%	0.21%	2.02%	0.12%	0.05%	1.51%
ICC*CS	**11.42%**	**9.48%**	**13.88%**	**10.42%**	0.08%	**8.33%**
TH*NC	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%
TH*CS	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%
NC*CS	1.24%	0.17%	0.27%	0.18%	3.27%	3.35%

Note. n =288,000. Degrees of freedom of the model was 65. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

Chi-square. NC main factor and ICC*CS two-way interaction were two effects which had larger effect sizes than 5% on the chi-square statistics across all the replications in the MBs. The η^2 effect size was 31.77% for NC main effect and 11.42% for ICC*CS interaction effect. Means and standard deviations of the chi-square statistics for the levels of NC were a mean of 61.75 with a standard deviation of 22.57 for NC=30, a mean of 77.35 with a standard deviation of 28.93 for NC=50, and a mean of 117.35 with a standard deviation of 46.75 for NC=100. The power rates for the levels of NC were 12.38% for NC=30, 33.30% for NC=50, and 73.12% for NC=100. Because ICC and CS had a two way interaction, means, standard deviations, and power rates of chi-square statistics by ICC and CS were cross-tabulated and results are provided in Table 42.

Table 42
Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by ICC and CS in the MBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	104.09	40.43	60.82%	79.18	23.52	30.83%
CS=50	79.16	41.47	32.75%	101.49	42.07	55.66%
CS=100	53.50	28.39	10.64%	95.50	45.45	46.90%

Note. n = 288,000. Degrees of freedom of the MBs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

CFI. All design factors and all their possible interactions accounted for 45.60 % of the total SOS (i.e., 104.097) of the CFI (see Table 41). Among all these main and interaction effects, CS main effect explained 26.17% and ICC*CS interaction effect explained 9.48% of the total SOS. All the others accounted for a negligible part of the SOS of CFI across all replications in the MBs. The overall mean of CFI across all replications in the MBs was 0.989 with a standard deviation of 0.019. Means, standard deviations, and power rates of CFI by ICC and CS are provided in Table 43.

Table 43
Mean, Standard Deviation, and Power Rates of CFI by ICC and CS in the MBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.964	0.030	26.48%	0.987	0.016	3.49%
CS=50	0.994	0.009	0.32%	0.993	0.007	0.10%
CS=100	0.999	0.003	0.00%	0.996	0.004	0.00%

Note. n = 288,000. Degrees of freedom of the MBs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

TLI. All design factors and all their possible interactions accounted for 51.20 % of the total SOS (i.e., 316.811) of the TLI (see Table 41). CS, NC, and ICC*CS effects accounted for 21.47%, 8.05%, and, 13.88% of the total SOS of the TLI respectively. Means and standard deviations of the TLI statistics for the levels of NC were a mean of 1.003 with a standard deviation of 0.039 for NC=30, a mean of 0.988 with a standard deviation of 0.030 for NC=50, and a mean of 0.981 with a standard deviation of 0.025 for NC=100. The power rates for the levels of NC were 7.24% for NC=30, 9.07% for NC=50, and 10.58% for NC=100. Means, standard deviations, and power rates of CFI by ICC and CS are reported in Table 44.

Table 44

Mean, Standard Deviation, and Power Rates of TLI by ICC and CS in the MBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.952	0.045	42.76%	0.988	0.033	8.97%
CS=50	1.000	0.020	1.44%	0.991	0.011	0.59%
CS=100	1.018	0.024	0.01%	0.996	0.007	0.03%

Note. n = 288,000. Degrees of freedom of the MBs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

RMSEA. All the design factors and all possible interactions accounted for 57.6 % of the total SOS (i.e., 44.896) of the RMSEA (see Table 41). Among all these main and interaction effects, CS, NC, and ICC*CS effects accounted for 35.15%, 5.16%, and 10.42% of the total SOS respectively. Means and standard deviations of the TLI statistics for the levels of NC were a mean of 0.008 with a standard deviation of 0.013 for NC=30, a mean of 0.011 with a standard deviation of 0.013 for NC=50, and a mean of 0.015 with a standard deviation of 0.011 for NC=100. The power rates for the levels of NC were 0.27% for NC=30, 0.22% for NC=50, and 0.08% for NC=100. For the ICC and CS effects, means, standard deviations, and power rates of RMSEA are provided in Table 45.

Table 45
Mean, Standard Deviation, and Power Rates of RMSEA by ICC and CS in the MBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.027	0.015	1.08%	0.016	0.013	0.05%
CS=50	0.006	0.007	0.00%	0.011	0.007	0.00%
CS=100	0.001	0.003	0.00%	0.007	0.005	0.00%

Note. n = 288,000. Degrees of freedom of the MBs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

SRMR. SRMR-W was not explored under MBs because SRMR-W is sensitive to within level specification. Only, SRMR-B was explored under MBs.

SRMR-B. All design factors and all their possible interactions accounted for 51.30 % of the total SOS (i.e., 1081.867) of the SRMR-B (see Table 41). CS, NC, ICC, and ICC*CS effects accounted for 15.35%, 10.56%, 6.43% and 8.33% of the total SOS respectively. Means and standard deviations of the SRMR-B statistics for the levels of NC were a mean of 0.204 with a standard deviation of 0.076 for NC=30, a mean of 0.175 with a standard deviation of 0.055 for NC=50, and a mean of 0.155 with a standard deviation of 0.036 for NC=100. The power rates for the levels of NC were

99.87% for NC=30, 99.21% for NC=50, and 98.97% for NC=100. For the ICC and CS effects, means, standard deviations, and power rates of SRMR-B are provided in Table 46.

Table 46
Mean, Standard Deviation, and Power Rates of SRMR-B by ICC and CS in the MBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.172	0.042	99.63%	0.253	0.087	99.98%
CS=50	0.158	0.040	98.61%	0.167	0.042	99.30%
CS=100	0.158	0.038	99.38%	0.162	0.040	99.19%

Note. n = 288,000. Degrees of freedom of the MBs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

Performance of the Fit Indices on the Simple Misspecified Within-Level Model

Overall means and standard deviations of the chi-square statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation are provided in Table 47. Note that SRMR-B means and standard deviations were exactly the same with the means and standard deviations (see Table 12) from the correctly specified model because the between level was correctly specified in MWs.

Table 47

Descriptive Statistics of the Fit Indices for the Simple Misspecified Within-Level Model by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	1029.97	1200.14	561.04	660.92
CFI	0.847	0.057	0.813	0.081
TLI	0.788	0.079	0.741	0.112
RMSEA	0.068	0.028	0.049	0.022
SRMR-W	0.096	0.011	0.096	0.011
SRMR-B	0.090	0.057	0.090	0.057

Note. n=288,000. Degrees of freedom of the MWs was 65. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

A series of full factorial ANOVAs were conducted to examine the effect of design factors on fit indices. Even though a full series of factorial ANOVAs were conducted, main affects and two-way interactions are reported in Table 48. Other three-, four-, five-, and six-way interactions explained trivial portions (i.e., η^2= 7.69% for chi-square, η^2= 1.63% for CFI, η^2= 1.59% for TLI, η^2= 1.36% for RMSEA, η^2= 0.78% for SRMR-W, and η^2= 2.86% for SRMR-B) of the sum of squares on the fit indices. The overall η^2 values in Table 48 represent the explained proportions of the corresponding fit indices by all six factors (i.e., estimation, number of categories, intra-class correlation, threshold, number of cluster, and cluster size), and their all possible two-, three-, four-, five-, and six-way interactions.

Table 48

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Simple Misspecifed Within-Level Model

Sources	Fit Index					
	Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	286141816425.83	1499.50	2886.75	213.343	33.747	946.988
Overal η^2	97.00%	62.70%	62.50%	87.00%	26.50%	75.3 %
EST	**5.53%**	**5.74%**	**5.71%**	**12.70%**	0.00%	0.00%
CAT	4.73%	0.67%	0.69%	**15.78%**	3.37%	1.53%
ICC	**15.63%**	**32.97%**	**32.84%**	**24.84%**	0.09%	**9.89%**
TH	0.00%	0.06%	0.06%	0.00%	0.00%	0.02%
NC	**19.98%**	2.91%	2.93%	2.13%	3.48%	**19.17%**
CS	**14.27%**	2.19%	2.17%	**15.94%**	**11.87%**	**23.78%**
EST*CAT	0.69%	0.01%	0.01%	0.67%	0.00%	0.00%
EST*ICC	1.08%	0.86%	0.86%	0.28%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	1.32%	0.44%	0.44%	0.09%	0.00%	0.00%
EST*CS	2.06%	0.81%	0.81%	0.01%	0.00%	0.00%
CAT*ICC	1.75%	0.05%	0.05%	1.17%	0.07%	0.62%
CAT*TH	0.06%	0.06%	0.06%	0.24%	0.09%	0.06%
CAT*NC	1.59%	0.07%	0.08%	0.01%	0.66%	0.13%
CAT*CS	0.83%	1.57%	1.60%	2.96%	3.41%	1.77%
ICC*TH	0.00%	0.01%	0.01%	0.01%	0.00%	0.01%
ICC*NC	3.71%	0.40%	0.40%	0.31%	0.01%	1.31%
ICC*CS	**9.35%**	**11.86%**	**11.83%**	**7.85%**	0.03%	**11.18%**
TH*NC	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.00%	0.01%	0.00%	0.02%
NC*CS	**6.71%**	0.38%	0.37%	0.65%	2.63%	2.95%

Note. n =288,000. Degrees of freedom of the MWs was 65. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

As shown in Table 48, all the design factors explained substantial proportions of the total SOS for chi-square (i.e., η^2= 97.0%) , CFI (i.e., η^2= 62.7%), TLI (i.e., η^2= 62.5%), RMSEA (i.e., η^2= 87.0%), and SRMR-B (i.e., η^2= 75.3%). All the design factors accounted for comparably a less proportion of the total SOS of SRMR-W (i.e., η^2= 26.5%). Based on the main and interaction effects which accounted for more than 5% of the total SOS of the fit indices, each of the fit indices were examined by providing their means, standard deviations, and their power rates for identifying incorrectly specified model (i.e., MWs) in the subsequent parts.

Chi-square. Four main design factors, NC, ICC, CS, EST, and two two-way interactions, ICC*CS, NC*CS accounted for a substantial part of the total SOS of chi-square across all the replications in the MWs. The η^2 effect sizes for these NC, ICC, CS, EST, ICC*CS, and NC*CS were 19.98%, 15.63%, 14.27%, 5.53%, 9.35%, and 6.71% respectively. EST main effect had an effect size of 5.53% and did not have any interaction with any other design factors. The means and standard deviations of the chi-square for the levels of EST are provided in Table 47. WLSM had a higher mean and standard deviation than WLSMV. The power rate of the WLSM was 98.82%, and the power rate of WLSMV was 96.02% based on the $p < 0.05$ critical value. Means, standard deviations, and power rates of the chi-square statistics for the MWs by NC, ICC, and CS are provided in Table 49.

Table 49

Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by Estimation, ICC, NC, and CS in the MWs

Number of Clusters	Cluster Size	High-ICC			Low-ICC		
		Mean	SD	Power	Mean	SD	Power
NC = 30							
	CS = 10	167.95	83.07	90.35%	188.61	96.96	92.42%
	CS = 50	179.34	84.62	96.72%	656.42	351.22	100.00%
	CS = 100	128.81	62.37	76.52%	806.09	439.95	100.00%
NC = 50							
	CS = 10	236.24	112.25	98.48%	265.23	124.72	99.10%
	CS = 50	363.78	175.66	100.00%	1090.99	519.35	100.00%
	CS = 100	280.68	152.93	99.93%	1520.14	751.20	100.00%
NC = 100							
	CS = 10	408.16	182.69	100.00%	452.94	194.27	100.00%
	CS = 50	987.05	445.12	100.00%	2207.68	926.81	100.00%
	CS = 100	861.27	475.51	100.00%	3517.72	1514.09	100.00%

Note. n=288,000. Degrees of freedom of the MWs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size. SD = Standard deviation.

CFI. All design factors and all their possible interactions accounted for 62.7 % of the total SOS (i.e., 1499.50) of the CFI (see Table 48). Among all these main and interaction effects, ICC explained 32.97%, EST explained 5.74%, and ICC*CS explained 11.86% of the total SOS. The mean of CFI was 0.847 with a standard deviation of 0.057 when the WLSM estimation was used, and 0.813 with a standard deviation of 0.081 when the WLSMV estimation was used. Both WLSM and WLSMV resulted in similar power rates across all replications in the MWs. The power rate of CFI for the WLSM estimation was 95.89%, and the power rate of CFI for the WLSMV was 96.16%. For ICC and CS design factors, means, standard deviations, and power rates of CFI are provided in Table 50.

Table 50

Mean, Standard Deviation, and Power Rates of CFI by ICC and CS in the MWs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.827	0.066	97.43%	0.813	0.066	98.08%
CS=50	0.878	0.040	96.83%	0.772	0.052	100.00%
CS=100	0.909	0.040	83.80%	0.780	0.043	100.00%

Note. n = 288,000. Degrees of freedom of the MWs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

TLI. TLI produced similar results to the CFI in the MWs. All design factors and all their possible interactions accounted for 62.5% of the total SOS (i.e., 2886.75) of the TLI (see Table 48). ICC and EST main factors accounted for 32.84 and 5.71% of the total SOS of the TLI respectively. The two way interaction, ICC*CS, accounted for 11.83 % of the total SOS. The mean of TLI was 0.788 with a standard deviation of 0.079 when the WLSM estimation was used, and 0.741 with a standard deviation of 0.112 when the WLSMV estimation was used. Both WLSM and WLSMV resulted in similar power rates across all replications in the MWs. The power rate of TLI for the WLSM estimation was 97.71%, and the power rate of TLI for the WLSMV was 97.85%. For ICC and CS design factors, means, standard deviations, and power rates of TLI are provided in Table 51.

Table 51
Mean, Standard Deviation, and Power Rates of TLI by ICC and CS in the MWs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.761	0.092	98.41%	0.742	0.093	98.70%
CS=50	0.831	0.055	98.76%	0.684	0.073	100.00%
CS=100	0.874	0.056	90.79%	0.696	0.059	100.00%

Note. n = 288,000. Degrees of freedom of the MWs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 87.0 % of the total SOS (i.e., 213.343) of the RMSEA (see Table 48). ICC, CS, CAT, EST main effects, and ICC*CS two way interactions accounted for 24.84%, 15.94%, 15.78%, 12.70%, and 7.85% of the total SOS of the RMSEA respectively.

The means and standard deviations of the levels of CAT main effect were 0.042 with standard deviation of 0.017 for two-level data, 0.056 with a standard deviation of 0.022 for three-level data, 0.066 with a standard deviation of 0.028 for five-level data, and 0.070 with a standard deviation of 0.031 for seven-level data. The means and standard deviations for the levels of EST main effect were 0.068 with a standard deviation of 0.028 for the WLSM, and 0.049 with a standard deviation of 0.023 for WLSMV. Power rates for the levels of CAT were 14.57% for two-level data, 45.93% for three-level data, 61.20% for five-level data, and 64.44% for seven-level data. Similarly, power rates for the levels of EST were 59.43% for WLSM and 33.65% for the WLSMV.

For the two way interaction of ICC*CS, means standard deviations, and power rates are provided in Table 52.

Table 52
Mean, Standard Deviation, and Power Rates of RMSEA by ICC and CS in the MWs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.069	0.024	62.14%	0.074	0.025	70.73%
CS=50	0.042	0.015	12.74%	0.077	0.020	77.87%
CS=100	0.025	0.012	0.10%	0.065	0.018	55.66%

Note. n = 288,000. Degrees of freedom of the MWs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

SRMR. SRMR-B was not explored under the MWs because SRMR-B is sensitive to between level specifications. Only, SRMR-W was explored under the MWs.

SRMR-W. All design factors and all their possible interactions accounted for 26.5 % of the total SOS (i.e., 33.747) of the SRMR-W (see Table 48). Among all main and two-way interactions, only CS had an effect size greater than 5%. The effect size for the main effect CS was 11.87. The means and standard deviations of the levels for the CS main effect were 0.101 with a standard deviation of 0.016 for CS=10, 0.093 with a standard deviation of 0.007 for CS=50, and 0.093 with a standard deviation of 0.005 for CS=100. Power rates were 93.59% for CS=10, 97.95 for CS=50, and 99.59 for CS=100.

Performance of the Fit Indices on the Simple Misspecified Between- and Within-Level Model

Overall means and standard deviations of the chi-square statistics, CFI, TLI, RMSEA, SRMR-W, and SRMR-B by estimation type are provided in Table 53. In this section, both within- and between-level models were simple misspecified. Previously, SRMR-W was explored under MWs, and SRMR-B was explored under MBs. Because SRMR-W is only sensitive to within level specifications and SRMR-B is only sensitive to between level specifications, both SRMR-W and SRMR-B were not explored in this section. Even if they were examined, the same results would be found for both SRMR-W and SRMR-B in the MWBs.

Table 53
Descriptive Statistics of the Fit Indices for the Simple Misspecified Between- and Within-Level Model by Estimation Method

	WLSM		WLSMV	
Fit Indices	Mean	SD	Mean	SD
Chi-square	919.21	1011.45	490.28	535.87
CFI	0.859	0.046	0.832	0.061
TLI	0.808	0.063	0.772	0.084
RMSEA	0.065	0.025	0.046	0.020
SRMR-W	0.096	0.011	0.096	0.011
SRMR-B	0.178	0.061	0.178	0.061

Note. n=288,000. Degrees of freedom of the MWBs was 66. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. SD = Standard deviation. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model.

A series of full factorial ANOVAs were conducted to examine the effect of design factors on fit indices. In Table 54, main affects and their two-way interactions were reported. Other three-, four-, five-, and six-way interactions explained trivial portions (i.e., η^2= 7.18% for chi-square, η^2= 1.30% for CFI, η^2= 1.32% for TLI, η^2= 1.36% for RMSEA, η^2= 0.44% for SRMR-W, and η^2= 2.86% for SRMR-B) of the SOS on the fit indices. The ANOVA results for SRMR-W and SRMR-B were also reported but the ANOVA results for SRMR-B were exactly same with the ANOVA results from the MBw, and the ANOVA results for SRMR-W were exactly same with the ANOVA results from the MWs because of the same misspecification in those models. The overall η^2 values in Table 54 represent the explained proportions of the corresponding fit indices by all six factors and all their possible two-, three-, four-, five-, and six-way interactions.

As shown in Table 54, all the design factors explained substantial proportions of the total SOS for chi-square (i.e., η^2= 97.14%), CFI (i.e., η^2= 56.40%), TLI (i.e., η^2= 56.24%), RMSEA (i.e., η^2= 87.85%), and SRMR-B (i.e., η^2= 51.30%). All the design factors accounted for a comparably less proportional part of the total SOS of SRMR-W (i.e., η^2= 26.50%). The ANOVA results for the fit indices in MWBs were very similar to ANOVA results from MWs. Even though the effect size values were different across these two misspecification conditions, the effects, which had a higher effect size value than 5%, were exactly the same effects in these both misspecifications.

Table 54

Sum of Squares and Eta-Squares (η^2) for the Fit Indices of the Simple Misspecifed Between- and Within-Level Model

Sources	Fit Index Chi-square	CFI	TLI	RMSEA	SRMR-W	SRMR-B
Total SOS	201919099741.249	902.553	1685.014	174.212	33.747	1081.867
Overal η^2	97.14%	56.40%	56.24%	87.85%	26.50%	51.30%
EST	**6.56%**	**5.66%**	**5.64%**	**15.31%**	0.00%	0.00%
CAT	4.89%	0.13%	0.13%	**15.21%**	3.37%	0.98%
ICC	**14.30%**	**24.71%**	**24.60%**	**20.71%**	0.09%	**6.43%**
TH	0.00%	0.07%	0.07%	0.00%	0.00%	0.01%
NC	**20.47%**	2.17%	2.19%	1.80%	3.48%	**10.56%**
CS	**15.02%**	3.40%	3.36%	**18.57%**	**11.87%**	**15.35%**
EST*CAT	0.71%	0.01%	0.01%	0.68%	0.00%	0.00%
EST*ICC	1.12%	0.54%	0.53%	0.25%	0.00%	0.00%
EST*TH	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EST*NC	1.67%	0.14%	0.14%	0.04%	0.00%	0.00%
EST*CS	2.16%	0.43%	0.43%	0.05%	0.00%	0.00%
CAT*ICC	1.72%	0.31%	0.32%	1.32%	0.07%	0.47%
CAT*TH	0.06%	0.04%	0.04%	0.23%	0.09%	0.04%
CAT*NC	1.53%	0.14%	0.15%	0.02%	0.66%	0.13%
CAT*CS	0.91%	0.66%	0.67%	2.44%	3.41%	1.28%
ICC*TH	0.00%	0.01%	0.01%	0.01%	0.00%	0.01%
ICC*NC	2.84%	1.04%	1.04%	0.45%	0.01%	1.51%
ICC*CS	**9.35%**	**15.46%**	**15.43%**	**8.84%**	0.03%	**8.33%**
TH*NC	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TH*CS	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
NC*CS	**6.64%**	0.15%	0.14%	0.54%	2.63%	3.35%

Note. n =288,000. Degrees of freedom of the MWBs was 66. η^2 was calculated by dividing the Type III sum of square by the total sum of square. CFI = Comparative fit index. TLI = Tucker-Levis index. RMSEA = Root mean square error approximation. SRMR-W = Standardized root mean square residual for within-model. SRMR-B = Standardized root mean square residual for between-model. SOS = Sum of squares. EST = Estimation. CAT = Number of Categories. ICC = Intra-class correlation. TH = Threshold. NC = Number of Cluster. CS = Cluster Size. η^2 effect sizes greater than 5% were bolded.

Chi-square. All design factors and all their possible interactions accounted for 97.14% of the total SOS of the chi-square statistics across all 288,000 replications in the MWBs. Main effects, NC, CS, ICC, EST, and two two-way interactions, ICC*CS, NC*CS accounted for a substantial proportion of the total SOS of the chi-square across all the replications in the MWBs. The η^2 effect sizes for these NC, CS, ICC, EST, ICC*CS, and NC*CS effects were 20.47%, 15.02%, 14.30%, 6.56%, 9.35%, and 6.64% respectively. EST main effect had an effect size of 6.56% and it did not have any interaction with any other design factors. The means and standard deviations of the chi-square for the levels of EST was a mean of 919.21 with a standard deviation of 1011.45 for the WLSM and a mean of 490.28 with a standard deviation of 535.87 for the WLSMV. The power rate for the WLSM was 99.12%, and the power rate for the WLSMV was 96.51% based on the $p < 0.05$ critical value. For the other effects, means standard deviations, and power rates of the chi-square statistics are provided in Table 55.

Table 55

Mean, Standard Deviation, and Power Rates of Chi-Square Statistics by ICC, NC, and CS in the MWBs

Number of Clusters	Cluster Size	High-ICC Mean	High-ICC SD	High-ICC Power	Low-ICC Mean	Low-ICC SD	Low-ICC Power
NC = 30							
	CS = 10	164.34	73.01	92.94%	174.18	83.14	91.66%
	CS = 50	180.91	79.84	97.95%	580.07	301.89	100.00%
	CS = 100	131.90	60.65	79.71%	733.64	386.19	100.00%
NC = 50							
	CS = 10	230.68	99.90	99.29%	242.95	107.44	99.13%
	CS = 50	355.60	161.94	100.00%	932.42	441.71	100.00%
	CS = 100	280.88	146.24	99.99%	1341.36	645.96	100.00%
NC = 100							
	CS = 10	396.64	165.02	100.00%	407.25	167.92	100.00%
	CS = 50	918.51	399.26	100.00%	1814.60	786.81	100.00%
	CS = 100	833.18	441.15	100.00%	2966.31	1290.87	100.00%

Note. n=288,000. Degrees of freedom of the MWBs was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. NC= Number of cluster. CS = Cluster size. SD = Standard deviation.

CFI. All design factors and all possible interactions accounted for 56.40% of the total SOS (i.e., 902.553) of the CFI (see Table 54). Among all these main and interaction effects, ICC explained 24.47%, EST explained 5.66%, and ICC*CS explained 15.46% of the total SOS. The mean of the CFI was 0.859 with a standard deviation of 0.046 when the WLSM estimation was used, and 0.832 with a standard deviation of 0.061 when the WLSMV estimation was used. Both WLSM and WLSMV resulted in similar power rates across all replications in the MWBs. The power rate of the CFI for the WLSM estimation was 96.46%, and the power rate of the CFI for the WLSMV was 96.80%. For ICC and CS design factors, means, standard deviations, and power rates of CFI are provided in Table 56.

Table 56

Mean, Standard Deviation, and Power Rates of CFI by ICC and CS in the MWBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.831	0.053	98.58%	0.836	0.053	98.03%
CS=50	0.881	0.035	97.58%	0.810	0.036	100.00%
CS=100	0.909	0.038	85.62%	0.809	0.033	100.00%

Note. n = 288,000. Degrees of freedom of the MWBs was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

TLI. TLI produced very similar results to the CFI in the MWBs. All design factors and all their possible interactions accounted for 56.24% of the total SOS (i.e., 1685.014) of the TLI (see Table 54). ICC and EST main factors accounted for 24.60 and 5.64% of the total SOS of the TLI respectively. The two way interaction, ICC*CS, accounted for 15.43 % of the total SOS. The mean of TLI was 0.808 with a standard deviation of 0.063 when the WLSM estimation was used, and 0.772 with a standard deviation of 0.084 when the WLSMV estimation was used. Both WLSM and WLSMV resulted in similar power rates across all replications in the MWBs. The power rate of the TLI for the WLSM estimation was 98.11%, and the power rate of the TLI for the WLSMV was 98.28%. For ICC and CS design factors, means, standard deviations, and power rates of TLI are provided in Table 57.

Table 57

Mean, Standard Deviation, and Power Rates of TLI by ICC and CS in the MWBs

	High-ICC			Low-ICC		
Cluster Size	Mean	SD	Power	Mean	SD	Power
CS=10	0.770	0.072	99.15%	0.776	0.072	98.67%
CS=50	0.838	0.048	99.19%	0.740	0.049	100.00%
CS=100	0.876	0.052	92.16%	0.739	0.045	100.00%

Note. n = 288,000. Degrees of freedom of the MWBs was 66. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

RMSEA. All the design factors and all their possible interactions accounted for 87.85 % of the total SOS (i.e., 174.212) of the RMSEA (see Table 54). ICC, CS, EST, and CAT main effects, and ICC*CS two way interactions accounted for 20.21%, 18.57%, 15.31%, 15.21%, and 8.84% of the total SOS of RMSEA respectively.

The means and standard deviations of the levels of CAT main effect were a mean of 0.041 with a standard deviation of 0.0152 for two-level data, a mean of 0.053 with a standard deviation of 0.020 for three-level data, a mean of 0.062 with a standard deviation of 0.025 for five-level data, and a mean of 0.066 with a standard deviation of 0.028 for seven-level data. The means and standard deviations for the levels of EST main effect were a mean of 0.065 with a standard deviation of 0.025 for the WLSM, and a mean of 0.046 with a standard deviation of 0.020 for the WLSMV. Power rates for the levels of CAT were 10.01% for two-level data, 37.28% for three-level data, 56.61% for five-level data, and 61.51% for seven-level data. Similarly, power rates for the levels of EST were 56.28% for the WLSM and 26.42% for the WLSMV. For the two way interaction of ICC*CS, means, standard deviations, and power rates are provided in Table 58.

Table 58
Mean, Standard Deviation, and Power Rates of RMSEA by ICC and CS in the MWBs

	High-ICC			Low-ICC		
	Mean	SD	Power	Mean	SD	Power
CS=10	0.067	0.022	61.31%	0.069	0.023	64.70%
CS=50	0.041	0.013	9.89%	0.070	0.019	67.34%
CS=100	0.025	0.011	0.03%	0.060	0.016	44.84%

Note. n = 288,000. Degrees of freedom of the MWs was 65. High ICC = High intra-class correlation. Low ICC = Low intra-class correlation. CS = Cluster size. SD=Standard deviation.

SRMR. Both SRMR-W and SRMR-B were not examined under the MWBs condition because SRMR-W was already explored under the MWs, and SRMR-B was already explored under the MBs.

CHAPTER V

DISCUSSION AND CONCLUSION

The present dissertation examined the performance of robust WLS (i.e., WLSM, WLSMV) estimation techniques with a correctly specified multilevel CFA model and six different misspecified multilevel CFA models (i.e., MBc, MWc, MWBc, MBs, MWs, MWBs) under varying levels of ICC, NC, CS, CAT, and TH. Results were examined for convergence rates, parameter estimates, standard error of parameter estimates, and performance of fit indices in the correctly specified model. Also, performances of the fit indices were examined under misspecified model conditions to determine whether they were effective in identifying the misspecified models based on commonly used cutoff values of these fit indices.

Convergence Failures

The number of convergence failures was exactly equal across all replications when WLSM or WLSMV estimation techniques were applied regardless of the other design factors (i.e., ICC, NC, CS, CAT, TH) because of the same procedure being used to estimate parameters and parameter standard errors (Muthén et al., 1997). Thus, WLSM and WLSMV were not explored separately regarding convergence rates. As another point, convergence failures were only reported for the correctly specified model. The reason of reporting convergence failures for the correctly specified model was that the highest convergence failures occurred in the true model among all the model specification conditions. One explanation for the higher convergence failures in the true model was that the true model had the highest number of parameters to be estimated compared to all other model specification conditions (Bandalos, 2014).

In the present simulation study, the overall convergence failure percentage for the correctly specified model was reasonable (i.e., 1.214%) even though a small number of CS (i.e., 10) and a small NC (i.e., 30) were included. In previous single-level simulation studies, it has been shown that robust WLS estimation techniques provided reasonable convergence failure rates (Beauducel & Herzberg, 2006; DiStefano & Morgan, 2014). Also, WLSM estimation technique resulted in a small number of replications with convergence problems in previous multilevel simulation studies (Asparouhov & Muthén, 2007; Hsu, 2009). The present simulation study resulted in similar findings with the previous simulation studies regarding convergence rates. The robust WLS estimation techniques performed well regarding convergence rates when clustered categorical/ordinal data were used under multilevel CFA models as presented in Table 3.

In the present simulation study, most of the convergence failures occurred when smaller NC or smaller CS were used. From previous simulation studies (e.g., DiStefano & Morgan, 2014), it is known that smaller sample sizes are most likely to produce nonconvergent results compared to larger samples. In the present dissertation study, sample sizes were originated by CS and NC, so the combination of these two simulation conditions was effective in terms of convergence rates. Increasing CS or NC reduced the nonconvergent replication percentages as demonstrated in Table 3. For example, NC = 50 resulted in a lower number of nonconvergent replications compared to NC = 30.

Similarly, CS = 50 resulted in a lower number of nonconvergent replications compared to CS = 10. These findings supported that smaller sample sizes (i.e., smaller CS or NC) cause more convergence problems compared to larger sample sizes.

The low-ICC condition also resulted in more nonconvergent replications compared to the high-ICC condition as demonstrated in Table 3. In the present simulation study, ICCs were manipulated by specifying different factor pattern coefficients values and different values for the residual variances in the between level model. In the low-ICC condition, the value of the factor pattern coefficients and residuals were lower than in the high-ICC condition. Smaller values for those parameters could possibly be the reason for the higher number of nonconvergent replications in the low-ICC condition. The other design factors, CAT and TH, did not result in large differences regarding nonconvergent replication numbers as shown in Table 3.

One of the objectives of the present simulation study was to compare the findings with the findings from Hsu et al. (2015). The same models were created in both studies, but there were some differences. Hsu et al. (2015) used continuous data by applying MLR estimation in a multilevel CFA model, and the present simulation study applied robust WLS estimation techniques with categorical/ordinal data in a multilevel CFA model. Hsu et al. (2015) indicated that their two-level CFA model did not provide any converged results when NC was equal to 50. In the present simulation study, when NC was equal to 50, the percentage of nonconvergent replications was 0.89%. Even though one of the levels of CS in the present simulation study was less than 50 (i.e., 30), still a high number of convergent replications were obtained. The reason for this might be that robust WLS does not require inverting the weight matrix (*W*), while MLR requires inverting the covariance matrix during the estimation procedure (Lei, 2009).

Parameter Estimate Bias

In the present simulation study, parameter bias was evaluated for factor pattern coefficients and factor correlation separately in both within- and between-level models. Because of the large number of factor pattern coefficients, average relative biases were reported. However, there was only one within level factor correlation and one between level factor correlation, so there was no need to average the correlation biases. As explained, both WLSM and WLSMV produced exactly the same estimates for the parameters in within- and between-level models, so estimation techniques were not a considered simulation design factor in terms of parameter biases.

Additionally, all parameter estimates were investigated by calculating their relative biases and their absolute relative biases across all replications in the true model. While absolute relative bias tells the magnitude of the bias without the direction (i.e., positive or negative), relative bias tells the direction with or without the magnitude of the bias. Thus, both of them were reported in the present simulation study.

Results showed that relative biases of the factor pattern coefficients were accurate in both within- and between-level models across ICC, CAT, NC, CS, and TH as shown in Table 4, but absolute relative biases indicated that the majority of the factor pattern coefficients were severely biased as presented in Table 6. Similarly, calculated relative biases for the factor correlations were trivial for the majority of the design conditions as shown in Table 5, but absolute relative biases were not trivial as shown in

Table 7. Because absolute relative biases revealed that the parameters were biased, the discussion about the parameter biases was mainly focused on the absolute relative biases. If only relative biases were calculated and interpreted, results of the present study would be misleading.

Increasing the NC and CS reduced the absolute relative biases for all kind of parameters in the between- and within-level models, but the decreases on the absolute relative biases for the between-level model parameters were not enough to say the model parameters were unbiased in the present simulation study. For the within-level model parameters, the large number of sample sizes provided unbiased parameter estimates based on the calculated absolute relative biases for both within-level factor pattern coefficients and correlation. For example, when NC was equal to 100 and CS was equal to 100, both the within-level factor pattern coefficients and correlation were unbiased regardless of the other design conditions.

Interpreting the relative biases without considering the absolute relative biases would cause incorrect conclusions about the parameter estimates in two-level CFA models when clustered categorical/ordinal data were used in the present study. In the literature, parameter estimates were found to be accurate when robust WLS estimation techniques were applied to categorical/ordinal data (e.g., Asparouhov & Muthén, 2007; Bandalos, 2014; Beauducel & Herzberg, 2006; DiStefano & Morgan, 2014; Lei, 2009). However, absolute relative biases were not considered when parameter estimates were investigated. That does not mean that the findings of those studies were incorrect, but it would be more trustworthy if absolute relative biases were also considered. In the present simulation study, if only relative biases were reported without absolute relative biases, same conclusions would be obtained from previous studies, but those results would be misleading from the present simulation study.

When applied researchers analyze clustered categorized ordinal data, they should be very careful when they report and interpret their parameter estimates. According to the present simulation study, within-level model parameters were unbiased when a large sample size was used, but between-level model parameters were biased even a large sample size was used (e.g., NC=100 and CS=100). Thus, researchers should not trust all their parameter estimates in two-level CFA models when robust WLS estimation techniques are applied to clustered categorical/ordinal data especially if they collect a small sample to fit their model.

The results of the present study revealed that increasing the NC and CS reduced the absolute relative biases for both factor-pattern coefficients and factor correlations in both between- and within-level models. Based on the simulation conditions of the present study, large sample sizes provided unbiased estimates for the within-level model parameters, but not for the between-level model parameters. Because increasing the NC and CS reduced absolute relative biases in a desired manner, there might be some larger sample sizes than the sample sizes which were manipulated in the present simulation study that may produce unbiased estimates for the between-level model parameters. However, more simulation studies are required to say that with more confidence.

Parameter Standard Error Bias

Similar to the investigation of parameter bias, standard error bias for the parameter was investigated for the standard error of the factor pattern coefficients and correlations in the between- and within-level models separately. Also, both relative biases and absolute relative biases of the standard errors of the parameters were examined as in the parameter estimate bias.

The results for the standard error relative biases of the parameters in the present simulation study were not consistent with the findings from previous single-level simulation studies (Bandalos, 2014; DiStefano & Morgan, 2014; Flora & Curran, 2004; Lei, 2009). The common finding among the previous single-level simulation studies was that standard errors of parameters were underestimated regardless of their design conditions. While some of them reported that standard error biases were negligible (e.g., Bandalos, 2014; Flora & Curran, 2004; Lei, 2009), some of researchers indicated that biases were not negligible (e.g., DiStefano & Morgan, 2014). As presented in Table 8, Table 9, Table 10, Table 11, Figure 3, Figure 4, Figure 5, and Figure 6, the standard error biases were not negligible most of the time in the present simulation study; and biases were found positive for some of the design cells, and found negative for other design cells.

As indicated previously, Asparouhov and Muthén (2007) conducted a simulation study to examine the behavior of the WLSM for a multilevel CFA model. They only simulated 100 replications by specifying NC =100 and CS = 10 with 5 level categorized ordinal data. They concluded that standard errors were estimated well based on the calculation of relative biases of the standard errors. In the present simulation study, for the same conditions, standard errors of the parameters were not substantially biased neither, but for most of the other design conditions, they were substantially biased.

Even though absolute relative biases for standard errors were not considered in the previous simulation studies, in the present simulation study, they were investigated with relative biases together. The majority of the relative biases were substantially biased as shown in Table 8 and 9, but there were a small number of design cells in which trivial biases were observed. On the other hand, when we examine the absolute relative biases for the standard errors of the parameters in both between- and within-level models, all the standard error estimates were substantial or moderately biased regardless of the considered simulation conditions. This revealed that when relative biases were calculated, overestimated and underestimated standard error biases cancelled out each other for the cells in which trivial biases were observed. Thus, both relative biases and absolute biases were required to see the behaviors of the robust WLS estimation techniques for the standard errors of the parameters.

General speaking, standard error estimates for the factor pattern coefficients and factor correlations in both within- and between-levels were biased (see Tables 8, 9, 10, 11; Figures 3, 4, 5, and 6). There were no clear distinctions among design conditions for overestimation or underestimation. Overestimating of the standard errors could make researchers to decide “statistically nonsignificant” for statistically significant parameters. On the other hand, underestimation of the standard errors could make researcher to decide “statistically significant” for statistically nonsignificant parameters. Thus, researchers should avoid interpreting statistical significance test results for parameter estimates based on multilevel CFA models when robust WLS estimation techniques are used regardless of ICC, NC, CS, CAT, and TH.

Chi-Square

To be able to say that WLSM and WLSMV perform well regarding Type I error control rates; it is expected to reject about 5% of the replications in a specified true model condition. In Appendix A (Table A-1), Type I error rates were provided across all of the simulation design factors. General speaking, WLSMV had better Type I error control rates than WLSM. When WLSMV estimation was used, Type I error rates were about 5% or smaller than 5% across CAT, ICC, NC, CS, and TH design factors. However, when WLSM was used, there were Type I error rate inflations for the some of the design factors. For the 5 or 7 level categorized ordinal data, Type I error rates were calculated between 10% and 20% when CS was equal to 10 regardless of ICC, NC, and TH. In both WLSM and WLSMV estimation techniques, some of the design cells produced 0% Type I error rates, especially when CS was increased.

Ideally, when a model is correctly specified, the chi-square test statistics of that model is expected to approach the model degrees of freedom, so in the present simulation study, the average chi-square statistics was expected to approach the true model degrees of freedom (i.e., 64). However, average chi-square statistics for most of the design conditions did not approach the correct model degrees of freedom as reflected in the means reported in Table 14 and in Appendix B Table B-1. Especially, increasing CS caused sharp decreases in average chi-square statistics. The decreases because of CS increase was observed in both WLSM and WLSMV, but the decrease was more dramatic when WLSM was applied. Decreases were sharper in the high-ICC condition than in the low-ICC condition. The only time when the average chi-squares were about the correct model degrees of freedom was that CS was equal to 10.

One explanation for the decrease because of CS increase might be that chi-square statistics that are from larger samples (i.e., CS) are penalized more (i.e., higher scaling correction factor) than they need to be. Previous single-level simulation studies (Bandalos, 2014; Flora & Curran, 2004; Potthast, 1993) showed that the full version of WLS resulted in inflated chi-square test statistics. As a result of that, Type I error rates were also higher than what would be expected. Because of this limitation of WLS, robust WLS estimation techniques applied some adjustments (i.e., scaling correction factors) to chi-square statistics to approach the chi-square distribution better (e.g., Bandalos, 2014; Beaudecel & Herzberg, 2006; DiStefano & Morgan, 2014; Lei, 2009). While WLSM only applies an adjustment to mean, WLSMV applies adjustments to both mean and variance. In the present simulation study, increasing CS probably caused higher scaling correction factors to adjust chi-square statistics.

Hsu (2009) indicated that average chi-square values approached his true model degrees of freedom (i.e., 68) well based on WLSM across all replications regardless of his dissertation design factors. However, he only simulated two different CS conditions as 10 and 15. In the present simulation study, when CS was equal to 10, chi-square estimations were also about the true model degrees of freedom. Underestimated chi-squares were found for the higher number of CS.

Power rates of chi-square statistics for the total of six different misspecification conditions were calculated across all design conditions (In Appendix A: MBc power rates in Table A-6; MWc power rates in A-11; MWBc power rates in A-16; MBs power rates in Table A-20; MWs power rates in Table A-25; MWBs power rates in Table A-30). General speaking, complex misspecifications resulted in lower power rates than simple misspecifications. Specifically, power rates of chi-square statistics in the between-level complex misspecification condition were 8.94% by WLSM and 3.26% by WLSMV; in the within-level complex misspecification condition were 66.83% by WLSM and 54.54% by WLSMV; and in the between- and within-level complex misspecification condition were 69.29% by WLSM and 56.85% by WLSMV. For the simple misspecification conditions, power rates of chi-square statistics in the between-level simple misspecification were 46.91% by WLSM and 32.29% by WLSMV; in the within-level simple misspecification were 98.82% by WLSM and 96.01% by WLSMV; and in the between- and within-level simple misspecification were 99.12% by WLSM and 96.51% by WLSMV.

In the complex misspecified between-level condition, all of the calculated power rates for across all of the design factors were under 40% (see Table 22 or Appendix A Table A-6). There were also some cells (e.g., when NC = 30 and CS = 100), in which 0% or close to 0% power rates were calculated. These results showed that the chi-square overall model test was not sensitive to detect between-level complex misspecification regardless of any design factors.

In the complex misspecified within-level and the complex misspecified between- and within-level models, similar results were found regarding chi-square statistics and power rates by all the simulation design factors (see Appendix A Table A-11 and A-16 for power rates; Appendix B Table B-11 and B-16 for chi-square statistics). In the low-ICC conditions, power rates were calculated higher than in the high-ICC condition as presented in Table 29 and 36. Even though there were design cells in which acceptable power rates were calculated (e.g., NC=100 and CS=100), there were still a remarkable number of cells in which unacceptable power rates occurred. Especially, in the high-ICC condition, when smaller NC and CS were used, power rates were below the desired power level (i.e., 80%). As indicated previously, WLSMV resulted in lower chi-square statistics than WLSM in the correctly specified model. The same situation was also observed in both the MWc and the MWBc conditions. Because of this situation, power rates by WLSMV were smaller than WLSM regardless of other simulation factors.

The CAT design factor did not account for a substantial part of the SOS of chi-square statistics across replications in both MWc and MWBc as presented in Table 28 and 35, but the smaller CAT resulted in lower power rates regardless of ICC, NC, CS, EST, and TH (see Appendix A: Table A-11, A-16). Especially, two level number of categories resulted in lower power rates than 80% when CS was equal to 10 regardless of other design factors.

In the simple misspecified between-level model condition, most of the power rates across all simulation conditions were under acceptable power rates (i.e., lower than 80%) as shown in Table 42 and under Appendix A in Table A-20. In the low ICC condition, when NC was equal to 100 with CS of 50 or CS of 100, power rates were above desired power level by both WLSM and WLSMV. In the high-ICC condition, when WLSM was used as an estimator, desired power rates were obtained for the design cells where NC = 100 and CS = 50 or NC =100 and CS = 10. Additionally, acceptable power rates were calculated for two and three level of categories when NC was equal to 100 and CS was equal to 50 in the high-ICC condition by using WLSMV. Last, when WLSMV was applied, acceptable power rates were calculated for all level of categories with NC =100 and CS = 10. Except these above cells, all of the power rates were under the desired power rate because of the underestimated chi-square test statistics.

For the MWs and MWBs misspecification conditions, similar results were found as presented in Table 49 and 55 (see Appendix A Table A-25 and A-30 for power rates; Appendix B Table B-25 and B-30 for chi-square statistics for detailed comparison). Even though EST, ICC, NC, and CS accounted for substantial parts of the total SOS of chi-square in both MWs and MWBs as shown in Table 48 and 54, power rates were above 80% for almost all design conditions in both MWs and MWBs. Power rates by WLSM were higher than power rates by WLSMV. Even though power rates were above 80% for most of the cells when WLSMV was used, there were still some cells in which power rates were under 80%: In both high- and low-ICC conditions, when NC was equal to 30 and CS was equal to 10, power rates were under 80% for the two-level categorized ordinal data. Also, in the high-ICC condition, for all levels of categorized ordinal data, when NC was equal to 30, and CS was equal to 100, power rates were not in the desired power level.

Among all the misspecification conditions, power rates were lower when the between-level was simple or complex misspecified. This implies that the chi-square test of overall model fit was not sensitive to between level misspecifications. Thus, chi-square overall model test results should not be used to evaluate between-level specifications in two level CFA models.

Even though the chi-square overall model test was stated as a priori to be false (Saris, Satorra, & van der Veld, 2009), this was not the case for the present simulation study. Normally, chi-square tests result rejecting null hypothesis with larger sample sizes when there were even very small discrepancies between a model implied covariance matrix and a population covariance matrix (Kline, 2011). However, in the present simulation study, chi-square overall tests failed to reject the null hypothesis (i.e., model fit to the data) for some of the misspecified models with larger samples sizes (e.g., MWBs when High-ICC, NC=30, CS=100 Est= WLSMV; MWc when High-ICC, NC=50, CS=100 Est=WLSM or WLSMV).

In terms of power rates of chi-square test statistics, WLSM provided better results than WLSMV. WLSM estimation technique worked well in terms of power rates when the within-level or both within- and between-level models were simple misspecified. However, both WLSM and WLSMV did not work well when the complex misspecification was applied to any level of the model. The behaviors of WLSM and WLSMV regarding chi-square test statistics were examined in all correctly and incorrectly specified model conditions. Both WLSM and WLSMV do not provide accurate estimates of chi-square test statistics in multilevel CFA models with categorized ordinal variables.

CFI, TLI, and RMSEA

CFI, TLI, and RMSEA showed somehow similar characteristics with the chi-square test in the present simulation study. It was expected because all three fit indices are calculated by using chi-square overall model test statistics at some point in their formulas. Even though chi-square is the only exact test for SEM models to evaluate the model fit to data (Barrett, 2007), researchers often report other fit indices (e.g., CFI, TLI, RMSEA) to evaluate their model because trivial deviations between a model implied covariance matrix and a population covariance matrix can result in rejecting the null hypothesis with large sample sizes (Kline, 2011).

When the correctly specified model was examined, all three fit indices correctly identified the true model by providing very high hit percentages by both WLSM and WLSMV (see Table 15 and Appendix Table A-7 for CFI; Table 16 and Appendix Table A-8 for TLI; Table 17 and Appendix A Table A-9 for RMSEA). Across all the 288,000 true model replications, the hit rate of CFI was 99.75%, the hit rate of TLI was 99.32%, and the hit rate of RMSEA was about 100% for correctly identifying the true model based on commonly used cutoff values (i.e., CFI > 0.95. TLI > 0.95, RMSEA < 0.06). Even though the CFI was confounded by CS; the TLI was confounded by ICC, NC, and CS; and the RMSEA was confounded by CS in the correctly specified model (see Table 13); they were still sensitive to identify correctly specified model regardless of the simulation design factors.

In the MBc, MWc, MWBc, and MBs misspecification conditions, all three fit indices were not sensitive to detect misspecifications based on commonly used cutoff values. In the MBc misspecification condition, power rates to detect the between level complex misspecification of CFI were 0.24% by WLSM and 0.56% by WLSMV; TLI power rates were 0.64% by WLSM and 1.35% by WLSMV; and RMSEA power rates were 0.003% by WLSM and 0% by WLSMV without considering other design factors. In the MWc misspecification condition, power rates to detect the within level complex misspecification of CFI were 1.91% by WLSM and 5.55% by WLSMV; TLI were 5.20% by WLSM and 13.95% by WLSMV; and RMSEA were 0.43% by WLSM and 0.01% by WLSMV. In the MWBc misspecification condition, power rates to detect the both between and within level complex misspecification of CFI were 2.55% by WLSM and 7.29% by WLSMV; TLI were 6.33% by WLSM and 15.99% by WLSMV; and RMSEA were 0.46% by WLSM and 0.01% by WLSMV. Last, in the MBs misspecification condition, power rates to detect the between level simple misspecification of CFI were 3.82% by WLSM and 6.31% by WLSMV; TLI were 7.42% by WLSM and 10.51% by WLSMV; and RMSEA were 0.38% by WLSM and 0% by WLSMV.

In these four misspecification conditions (i.e., MBc, MWc, MWBc, MBs), different design factors counfounded these fit indices differently (i.e., CFI, TLI, RMSEA) as shown in Table 21, 28, 38, and 44, but power rates never approached or exceeded the desired power level which is about 80% in any of the design cells. The reason why these fit indices behaved poorly to detect misspecification in the four misspecification conditions is that the chi-square overall model test statistics were not estimated accurately as explained under the chi-square discussion.

CFI and TLI fit indexed were sensitive to detect model misspecifications in MWs and MWBs conditions for almost all of design cells (see Appendix Table A-26 and A-31 for CFI; see Appendix Table A-27 and A-32 for TLI). Lower power rates (i.e, between 60% and 80%) were observed in the high-ICC conditions when the NC was equal to 30 and CS was equal to 100. Other than those cells, both WLSM and WLSMV based CFI and TLI provided reasonable power rates to detect misspecification in the MWs and MWBs conditions. Even though both CFI and TLI provided reasonable power rates across design factors, TLI performed better than CFI by providing higher power rates across all design factors.

CFI and TLI reasonably performed well to detect model misspecifications in MWs and MWBs conditions, but RMSEA did not perform well for the most of the design conditions (see Appendix A Table A-28 and A-33 for details). WLSM or WLSMV based RMSEA was confounded by the design factors of CAT, ICC, and CS in both MWs and MWBs misspecification conditions as shown in Table 48 and 54. Comparably, WLSM based RMSEA performed better than WLSMV based RMSEA, but most of the power rates were still unreasonable.

In the low-ICC condition, for the three, five, and seven level categorized ordinal data, WLSM based RMSEA statistics provided reasonable power rates for the MWs and MWBs misspecifications regardless of NC, CS, and TH. Also, in the high-ICC condition, WLSM based RMSEA values provided acceptable power rates for the three, five, and seven level categorized ordinal data when CS was equal to 10. Last, for the five- and seven-level categorized ordinal data, WLSM based RMSEA were also provided acceptable power rates when NC was equal to 100, and CS was equal to 50 in the high-ICC condition. Power rates by WLSM for the remaining cells were low, indeed there were some cells in which 0% power rates were observed.

In conclusion, CFI and TLI should not be used to decide whether factor pattern coefficients were correctly specified in within- or between-level models in multilevel CFAs. While CFI and TLI can be used to detect whether factor correlations in within level model were correctly specified, they should not be used to evaluate the specification of between level factor correlations.

Among these examined fit indices, RMSEA had the poorest results for detecting the misspecifications. Even thought there were some conditions in which RMSEA can identify misspecifications in MWs and MWBs, it would be better not to use RMSEA for model evaluation. One might suggest using a more conservative cutoff value for RMSEA in multilevel CFA models when WLSM or WLSMV estimation is used, but that cutoff value would not be sufficient at some point because of the confounders. For example, CS was a confounder for RMSEA in all model specification conditions, so even if a new cutoff value was assigned to detect misspecifications, in some sample sizes that specified cutoff value again would not provide accurate results.

SRMR-B and SRMR-W

Chi-square, CFI, TLI, and RMSEA are all used to evaluate the specified multilevel model as a whole. However, SRMR-W and SRMR-B are level specific fit indices. While SRMR-W is only sensitive to within-level model specifications, SRMR-B is only sensitive to between-level model specifications. Because of that, in the present simulation study, SRMR-W was examined in the correctly specified model by checking its hit rates to correctly identify the true within-level model, and also examined in the MWc and MWs misspecification conditions by checking its power rates for identifying misspecifications in the within-level structures. Similarly, SRMR-B was examined in the correctly specified model by checking its hit rates to identify the true between-level structure, and also examined in MBc and MBs misspecification conditions by checking its power rates for identifying misspecifications in the between-level structures. Also, mean values of SRMR-W and SRMR-B across the considered simulation conditions were examined in corresponding misspecification conditions.

In the correctly specified within-level model, SRMR-W provided very high hit rates regardless of ICC, NC, CS, CAT, and TH design factors as presented in Table 18 (see also Appendix A Table A-5 for details). The only condition in which lower power rates were found was when NC was equal to 30 and CS was equal to 10 with two-level categorized ordinal data in the high-ICC condition. Even though, CAT, NC, and CS accounted for a substantial part of the SOS of SRMR-W across replications in the true within-level model conditions as shown in Table 13, the means for the levels of these factors were all under the commonly used cutoff value of 0.08 with low standard deviations (i.e., between 0.005 and 0.02) as provided in Table 18.

In the MWc misspecification conditions, SRMR-W did not work well based on commonly used cutoff value as presented in Table 33. The overall power rate was 1.71% for identifying complex misspecification in the within-level model. The highest power rates were observed in high-ICC condition when NC was equal to 30 and CS was equal to 10 with two level categorized ordinal data (see Appendix A: Table A-15). For the most of the design conditions, power rates were around 0%.

In the MWs misspecification condition, SRMR-W worked well for identifying simple misspecification in the within level based on the commonly used cutoff value (see Appendix A: Table A-29 for details). The overall power rate of SRMR-W to detect within-level simple misspecification was 97.04%. Across all of the design cells, the lowest hit rate was about 90%. Even though CS accounted for 11.87% of the total SOS of SRMR-W in the MWs replications as shown in Table 48, the means across ICC, NC, CS, CAT, and TH were between 0.119 and 0.092 (see Appendix B: Table B-29 for details). Also, standard deviations were very low (i.e., between 0.019 and 0.003).

As a suggestion for applied researchers, they should be very careful when they test their within-level structure by using SRMR-W statistics. Even though SRMR-W worked well to identify correctly specified within-level models based on the commonly used cutoff value, it did not work well for identifying complex misspecifications in the within-level. Thus, one may conclude a within-level model is correctly specified, but indeed that model does not represent the population within-level model because of the misspecified factor pattern coefficients. One might suggest using more conservative (smaller) cutoff values for SRMR-W to identify complex misspecifications in within-level models when robust WLS estimation techniques used for clustered ordinal data. However, this would not be an appropriate solution. In the present simulation study, to be able to obtain an overall power rate around 80% in the MWc misspecification condition, SRMR-W cutoff value needs to be chosen about 0.033. However, when this cutoff value was used in the correctly specified models, hit rates for identifying correctly specified within-level structure would be lower than what they should be. For example, when we use 0.033 cutoff value, hit rates would be about 0% for the cells in which two-level categorized data used with NC=30 and CS=10.

In the correctly specified model, SRMR-B did not perform well for identifying correct between-level structure based on commonly used cutoff value (see Appendix A: Table A-5 for details). The overall hit rate of SRMR-B in the correctly specified model was 55.01% across all 288,000 replications. The means of SRMR-B decreased when NC and CS increased as shown in Table 19. Also, in the high-ICC condition, lower SRMR-B values were estimated compared to the low-ICC condition. Because of these dynamics, hit rates calculated higher for the bigger number of NC, CS, and for the high-ICC conditions. In the high-ICC conditions, acceptable hit rates were found when NC was equal to 50 and CS = 50 or 100; and when NC was equal to 100 regardless of CS, CAT, and TH factors. In the low-ICC condition, acceptable hit rates were calculated when NC was equal to 100 and CS was equal to 50 or 100 regardless of other design factors; and power rates were higher than 80% for the five and seven level categorized ordinal data when NC was equal to 50 and CS was equal to 100.

In the MBc misspecification condition, SRMR-B did not performed well for identifying the between-level complex misspecification (see Appendix A: Table A-10 for details). The overall power rate was about 67.7% across all replications based on the 0.08 cutoff value. As in the correctly specified model, SRMR-B values decreased when CS and NC increased in the MBc misspecification condition as shown in Table 26 and Appendix A Table A-10. Even though desirable power rates were calculated for the small NC (i.e., 30) and small CS (i.e., 10), the power rates were getting lower than 80% for the higher NC, and CS, especially in the high-ICC condition. Hit rates of SRMR-B in the correctly specified model, and power rates of SRMR-B in the MBc showed opposite trends. This indicates that SRMR-B does not take into account between model complex misspecification in the calculation process. An ideal situation would be estimating higher hit rates in the correctly specified model, and estimating higher power rates in the MBc, regardless of the simulation design factors.

SRMR-B power rates based on the 0.08 cutoff value was always higher than 98% in any of the design cells by ICC, CAT, NC, CS, and TH when simple misspecification was applied to the between level (see Table 46 and Appendix A: Table A-24). Even though high power rates were obtained in the MBs misspecification condition, there is no guarantee that SRMR-B will perform well for detecting the between level simple misspecification regardless of the design factors. Because of the poor performance of SRMR-B in the correctly specified model (especially for the low-ICC condition when low sample sizes were used), one can incorrectly decide that between level factor correlations were misspecified, but indeed there would not be any misspecification for between factor correlations.

Implications and Recommendations

In the present Monte Carlo study, the behaviors of robust weighted least square estimation techniques (i.e., WLSM and WLSMV) were investigated in multilevel CFA models with categorical/ordinal data under various conditions. Even though previous single-level and multilevel simulation studies showed that robust weighted least square estimation techniques worked well in multilevel CFA models with categorical/ordinal data regarding parameter estimates, standard error estimated of the parameters, and fit indices, the present simulation study revealed several opposite findings.

First, standard errors of parameters were severely biased in most of the design conditions. Sometimes, they were severely overestimated, and sometimes, severely underestimated. The overestimation can cause statistically significant parameters to be interpreted as not statistically significant, and the underestimation can cause statistically not significant parameters to be interpreted as statistically significant. Thus, researchers should avoid interpreting parameter estimates whether they are statistically significant or not in both within- and between-levels even when those parameter estimates were not biased at all.

Second, chi-square statistics did not follow the traditional chi-square test distribution. Ideally, when a model is correctly specified, it is expected that estimated chi-square statistics will approach the model degrees of freedom. In the present study, when the model was correctly specified, average chi-square statistics did not approach the model degrees of freedom for most of the design conditions. Even when the model was misspecified, the average chi-square statistics was calculated lower than the models' degrees of freedoms for some of the design conditions. The underestimation of chi-square statistics reduced the power rates for detecting misspecified models. Thus, when WLSM or WLSMV estimation techniques are applied to clustered categorical/ordinal data in multilevel CFA models, researchers are likely to interpret a misspecified multilevel model as a correct model.

Third, CFI, TLI, and RMSEA were not sensitive to misspecifications in most of the present simulation design conditions. Because of the inaccurate chi-square statistics, these fit indices also failed to detect misspecified models. Even though CFI and TLI detected misspecifications when the within factor correlation was misspecified (i.e., MWs, MWBs), they failed to detect misspecifications in factor pattern coefficients and in the between-level factor correlation. Because a misspecification is a misspecification regardless of simple or complex, trusting these fit indices may result again interpreting a misspecified multilevel model as a correct model.

Fourth, SRMR-W was not sensitive to all within-level misspecification conditions, and similarly SRMR-B was not sensitive to all between-level misspecification conditions. Even though SRMR-W was sensitive to the misspecification in the within-level factor correlation, it failed to detect misspecifications in the within-level factor pattern coefficients, so it is dangerous to use SRMR-W to conclude whether a within-level model is correctly specified or not. Similar to SRMR-W, SRMR-B provided high power rates when the between-level factor correlation was misspecified. However, SRMR-B did not provide desirable hit rates when the between-level model was correctly specified, and also did not provide acceptable power rates when the between-level factor pattern coefficients were misspecified. Because of the poor performance of SRMR-B in the correctly specified model, and in the complex misspecifed between-level model, researchers should avoid drawing conclusions about the model fit to data based on SRMR-B statistics.

The following points can be summarized from the present simulation:

- WLSM or WLSMV produce biased chi-square overall model test statistics.
- All examined fit indices (i.e., CFI, TLI, RMSEA, SRMR-W, and SRMR-B) do not work well to identify misspecifications in the between- and within-level models.
- Standard error estimates of the parameters were biased in the between- and within-level models, so never evaluate the parameter estimates based on statistical significance test results.
- Large numbers of CS (preferably with big NC) are required to obtain unbiased within-level model parameters. The highest NC and CS levels in the present simulation study still produced biased between-level parameter estimates, but the trend of the bias revealed that increasing the CS and NC reduced the bias, so larger NC and CS may provide unbiased parameter estimates in between-level models. More simulation studies are required to examine the parameter biases in between-level models.

- As a conclusion, all fit indices and chi-square test statistics can cause researchers to interpret their model fit results incorrectly based on the traditional cutoff values. Even though unbiased parameter estimates were found when the model was correctly specified, we cannot be sure that our specified model is the true population model, so it is better not to use robust WLSM or WLSMV estimation techniques in the multilevel CFA models when clustered categorical/ordinal data are present.

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APPENDIX A

CHI-SQUARE TYPE I AND POWER RATES, AND FIT INDICES HIT RATES AND POWER RATES

In Appendix A, chi-square Type I error rates were provided across EST, CAT, ICC, NC, CS, and TH simulation design factors in the correctly specified model. For the other fit indices, CFI, TLI, RMSEA, SRMR-W, and SRMR-B, hit rates for identifying the correctly specified model were provided based on traditional cut off values of these fit indices. The hit rates of CFI, TLI, and RMSEA were provided by considering EST, CAT, ICC, NC, CS, and TH simulation design factors. The hit rates of SRMR-W and SRMR-B, EST was not a considered design factor because both WLSM and WLSMV resulted in exactly same estimates for these fit indices.

Under the misspecified model conditions (i.e., MBc, MWc, MWBc, MBs, MWs, MWBs), power rates of chi-square were provided by EST, CAT, ICC, NC, CS, and TH simulation design factors. Similarly, power rates of CFI, TLI, RMSEA, SRMR-W, and SRMR-B were provided based on traditional cutoff values across simulation desing conditions.

Table A-1

Type I Error Rates by ICC, Estimation, Number of Categories, Number of Cluster, Cluster Size, and Threshold

Number of Clusters	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	4.2	5.7	10.9	17.2	0.4	0.7	1.9	2.7
		Th2	6.1	6.1	10.5	13.9	0.9	0.7	1.6	2.4
	CS=50	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
	CS=100	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
NC =50										
	CS=10	Th1	6.3	7.7	12.0	13.6	1.2	1.4	3.0	4.0
		Th2	6.5	7.9	10.5	13.5	1.3	2.1	3.2	3.9
	CS=50	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
	CS=100	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
NC =100										
	CS=10	Th1	6.5	8.7	10.5	12.8	2.3	3.5	3.7	4.9
		Th2	7.4	8.0	10.9	12.1	2.7	2.6	4.4	5.9
	CS=50	Th1	0.3	0.1	0	0	0.1	0	0	0
		Th2	0.3	0	0	0	0.1	0	0	0
	CS=100	Th1	0	0	0	0	0	0	0	0
		Th2	0	0	0	0	0	0	0	0
Low-ICC										
NC =30										
	CS=10	Th1	2.3	5.8	10.9	18.2	0.3	0.6	1.4	4.6
		Th2	2.5	6.6	13.6	20.0	0.2	0.6	1.6	4.6
	CS=50	Th1	2.9	1.5	2.9	2.9	0.1	0.1	0.2	0.2
		Th2	2.4	2.4	1.9	2.2	0.2	0	0.2	0.3
	CS=100	Th1	0.3	0	0	0	0	0	0	0
		Th2	0.6	0.1	0	0.1	0	0	0	0
NC =50										
	CS=10	Th1	4.5	7.9	11.5	17.1	0.9	1.4	3.0	4.6
		Th2	3.4	7.5	13.2	18.2	0.8	1.8	3.6	5.0
	CS=50	Th1	3.9	3.6	4.1	4.5	0.4	0.2	0.3	0.4
		Th2	4.0	3.6	2.7	3.4	0.6	0.7	0.2	0.4
	CS=100	Th1	0.1	0.1	0.1	0	0	0	0	0
		Th2	1.0	0	0	0	0.1	0	0	0
NC =100										
	CS=10	Th1	6.4	9.6	10.6	13.8	1.5	3.7	4.4	5.8
		Th2	6.5	9.0	10.3	12.8	2.5	2.7	4.0	5.9
	CS=50	Th1	5.6	4.8	4.0	4.8	1.8	1.1	0.9	1.1
		Th2	4.8	5.3	3.9	5.1	1.8	1.9	1.0	1.1
	CS=100	Th1	1.3	1.0	0.1	0.3	0.3	0.1	0	0
		Th2	2.3	1.3	0.2	0.1	0.4	0	0	0

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-2

CFI Hit Rates for the Correct Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	97.40	99.00	99.20	99.70	93.60	97.50	97.90	98.40
		Th2	94.30	99.00	99.50	100.00	91.20	97.70	99.00	98.60
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.40	99.90	100.00	100.00	97.40	99.30	99.70	99.70
		Th2	98.70	100.00	100.00	100.00	96.30	99.50	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.80	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	98.90	99.50	99.60	99.70	97.70	98.00	99.00	98.50
		Th2	97.40	99.50	99.70	100.00	96.20	98.30	99.30	99.40
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.80	99.90	100.00	100.00	98.70	99.60	99.90	100.00
		Th2	99.40	99.90	100.00	100.00	98.60	99.50	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.80	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-3

TLI Hit Rates for the Correct Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	92.60	96.80	97.90	98.10	89.00	93.90	94.70	95.40
		Th2	89.00	97.10	98.50	98.60	85.70	93.90	95.90	96.40
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	97.20	99.40	99.90	99.80	93.90	97.60	98.60	98.90
		Th2	96.00	99.50	100.00	100.00	91.70	97.20	99.10	99.20
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	99.60	99.90	100.00	100.00
		Th2	99.90	100.00	100.00	100.00	99.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	96.70	97.60	98.60	98.10	94.10	94.70	95.90	95.00
		Th2	95.50	97.80	99.00	99.20	94.10	95.20	96.40	95.30
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.90	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	98.00	99.60	99.70	100.00	96.70	98.30	99.30	99.70
		Th2	98.00	99.60	100.00	100.00	95.50	98.70	99.60	99.30
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	99.90	100.00	100.00	100.00	99.80	99.90	100.00	100.00
		Th2	99.90	100.00	100.00	100.00	99.20	99.90	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-4

RMSEA Hit Rates for the Correct Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	100.00	99.90	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	100.00	100.00	100.00	99.70	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-5

SRMR Hit Rates for the Correct Model

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
SRMR-Within										
NC =30										
	CS=10	Th1	73.80	99.90	100.00	100.00	97.00	100.00	100.00	100.00
		Th2	49.00	99.90	100.00	100.00	77.80	99.90	99.90	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.70	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	98.40	100.00	100.00	100.00	99.90	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SRMR-Between										
NC =30										
	CS=10	Th1	2.10	6.80	11.20	12.50	0.00	0.00	0.00	0.00
		Th2	1.40	6.50	12.20	12.90	0.00	0.00	0.10	0.10
	CS=50	Th1	34.80	38.50	40.50	41.30	8.40	12.00	16.50	15.90
		Th2	31.70	38.60	40.20	41.20	4.80	12.70	16.10	16.40
	CS=100	Th1	40.20	39.30	36.70	35.60	22.50	27.60	31.00	30.50
		Th2	38.10	37.00	36.50	35.60	18.80	29.00	32.10	30.30
NC =50										
	CS=10	Th1	25.10	43.20	54.10	57.60	0.10	0.20	0.30	0.90
		Th2	17.70	43.40	59.00	59.40	0.00	0.20	0.50	0.80
	CS=50	Th1	85.80	87.20	88.10	88.80	46.60	57.70	64.50	66.50
		Th2	82.60	87.40	89.20	89.10	33.60	57.80	67.40	67.80
	CS=100	Th1	87.90	87.30	87.70	87.30	72.60	78.90	82.20	82.00
		Th2	86.40	87.50	86.70	86.50	68.70	78.70	83.30	83.10
NC =100										
	CS=10	Th1	93.60	97.70	98.70	99.10	0.90	7.70	19.40	26.10
		Th2	88.90	97.90	99.50	99.70	0.30	7.60	22.00	27.30
	CS=50	Th1	100.00	100.00	100.00	100.00	98.10	99.10	99.30	99.40
		Th2	100.00	100.00	100.00	100.00	96.90	98.80	99.50	99.50
	CS=100	Th1	100.00	100.00	100.00	100.00	99.70	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.70	99.90	100.00	100.00

Note. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-6

Rejection Rates (Power) of Chi-Square Test Statistics for the Complex Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	6.30	9.00	15.90	24.60	.50	1.00	2.50	4.10
		Th2	7.80	8.80	13.30	18.70	1.30	1.10	2.40	3.80
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	12.00	15.50	21.80	27.30	3.00	4.00	7.60	9.50
		Th2	11.40	15.60	21.20	26.80	2.20	4.50	6.70	8.10
	CS=50	Th1	.30	.00	.00	.00	.00	.00	.00	.00
		Th2	.60	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	22.40	29.60	36.20	40.00	11.10	16.70	19.20	23.60
		Th2	21.20	28.10	35.90	39.00	9.80	15.50	19.20	22.90
	CS=50	Th1	6.20	2.30	.50	.20	1.80	.20	.00	.00
		Th2	5.80	1.30	.40	.20	1.20	.10	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	3.30	6.60	13.30	22.00	.30	.90	1.40	4.60
		Th2	2.30	8.20	15.50	21.60	.30	.90	2.10	5.90
	CS=50	Th1	4.50	3.60	4.70	4.70	.20	.20	.20	.30
		Th2	3.70	3.50	3.20	3.70	.60	.00	.20	.20
	CS=100	Th1	.50	.00	.00	.00	.00	.00	.00	.00
		Th2	1.10	.10	.00	.10	.00	.00	.00	.00
NC =50										
	CS=10	Th1	6.30	11.40	17.00	23.60	1.40	2.30	4.90	7.40
		Th2	4.60	11.70	18.10	26.00	.70	2.70	5.70	8.00
	CS=50	Th1	9.60	10.50	10.20	11.10	2.00	1.80	2.20	2.70
		Th2	9.50	9.60	7.80	9.80	2.50	2.00	2.00	2.20
	CS=100	Th1	1.80	.70	.30	.10	.00	.00	.00	.00
		Th2	2.60	.30	.00	.10	.20	.00	.00	.00
NC =100										
	CS=10	Th1	11.70	17.80	21.10	25.90	4.80	8.80	10.50	13.60
		Th2	10.80	17.10	21.50	25.20	3.70	7.90	10.60	13.50
	CS=50	Th1	21.70	27.20	27.20	30.80	12.00	14.50	13.60	14.80
		Th2	20.80	27.30	28.10	29.50	10.70	12.80	12.30	13.80
	CS=100	Th1	13.40	9.00	7.10	6.40	5.30	2.40	1.20	.50
		Th2	14.10	7.50	5.60	5.50	5.10	2.40	1.00	.50

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-7

CFI Power Rates for the Complex Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	4.70	1.90	.80	.60	8.60	3.60	3.10	2.20
		Th2	8.60	1.80	.70	.00	12.80	3.80	2.10	2.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	2.00	.40	.00	.00	5.70	1.90	.90	.50
		Th2	3.00	.10	.00	.00	7.60	1.50	.20	.20
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.40	.00	.00	.00
		Th2	.20	.00	.00	.00	1.00	.10	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	2.10	1.00	.30	.30	3.80	2.00	1.40	1.70
		Th2	3.00	.90	.40	.10	.00	2.10	1.20	.80
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00		.00	.00	.00
NC =50										
	CS=10	Th1	.50	.20	.00	.00	2.10	.50	.30	.10
		Th2	.70	.20	.00	.00	1.80	.70	.10	.10
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.20	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-8

TLI Power Rates for the Complex Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	10.20	4.40	3.40	2.70	14.70	9.40	7.10	6.40
		Th2	15.10	4.10	2.40	2.20	18.00	8.00	5.20	4.50
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	6.20	1.50	.70	.20	12.20	6.20	3.70	2.30
		Th2	7.80	1.60	.10	.10	14.00	5.20	2.20	1.30
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.50	.00	.00	.00	4.70	1.10	.40	.30
		Th2	1.20	.00	.00	.00	5.00	1.00	.30	.10
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	3.90	2.50	1.60	2.00	6.30	5.30	4.60	4.80
		Th2	4.60	2.80	1.20	1.10	5.60	5.60	3.70	4.10
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.10	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	3.10	.60	.40	.10	4.90	2.80	.80	.90
		Th2	2.60	.70	.00	.10	5.30	2.40	.70	.70
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.10	.00	.00	.00	.50	.20	.10	.10
		Th2	.20	.00	.00	.00	1.60	.30	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-9

RMSEA Power Rates for the Complex Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	.00	.10	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	.00	.00	.00	.30	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-10

SRMR-B Power Rates for the Complex Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
NC =30										
	CS=10	Th1	98.80	97.90	96.10	95.60	100.00	100.00	100.00	100.00
		Th2	99.30	98.20	94.60	95.00	100.00	100.00	100.00	100.00
	CS=50	Th1	84.80	83.20	81.40	82.20	97.00	95.10	93.40	94.00
		Th2	85.90	82.70	82.40	81.90	97.80	95.50	93.20	93.20
	CS=100	Th1	83.00	83.90	85.20	86.40	90.20	89.20	87.80	88.50
		Th2	85.10	85.00	85.10	85.50	93.60	87.90	88.40	87.00
NC =50										
	CS=10	Th1	92.70	84.80	78.60	75.70	100.00	100.00	99.90	99.90
		Th2	95.40	83.80	76.20	75.30	100.00	100.00	100.00	99.90
	CS=50	Th1	54.70	50.30	50.20	49.70	84.10	76.90	72.00	71.60
		Th2	57.40	51.90	49.20	49.30	88.90	77.50	71.70	71.40
	CS=100	Th1	50.00	49.90	51.30	51.30	65.70	62.70	60.70	61.20
		Th2	51.80	51.40	52.80	52.80	68.90	62.50	61.40	61.90
NC =100										
	CS=10	Th1	51.00	36.70	30.10	29.60	99.90	98.60	94.50	92.70
		Th2	57.20	36.10	28.80	28.20	100.00	97.90	93.20	92.10
	CS=50	Th1	15.20	14.70	14.00	13.50	36.20	32.10	28.70	27.10
		Th2	16.60	14.10	13.50	13.40	43.80	30.90	26.60	26.20
	CS=100	Th1	10.70	11.40	11.50	11.90	18.60	16.60	16.00	17.20
		Th2	11.90	10.60	12.30	12.80	22.00	16.10	15.10	16.80

Note. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-11

Rejection Rates (Power) of Chi-Square Test Statistics for the Complex Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	14.10	29.80	53.20	66.50	2.00	7.00	22.00	36.30
		Th2	15.80	30.90	55.50	68.30	3.20	8.20	24.20	36.30
	CS=50	Th1	1.90	2.60	2.70	2.20	.20	.10	.10	.00
		Th2	1.40	1.30	2.10	2.00	.00	.00	.10	.10
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.10	.00	.00	.00	.00
NC =50										
	CS=10	Th1	27.30	49.50	75.90	85.10	10.40	25.90	51.90	66.50
		Th2	23.40	52.50	79.20	86.70	8.40	27.50	58.90	69.60
	CS=50	Th1	37.60	52.60	60.80	65.00	9.20	13.20	16.00	17.30
		Th2	29.20	48.50	62.50	66.80	6.50	9.10	14.90	16.30
	CS=100	Th1	3.70	4.20	5.00	5.30	.00	.00	.00	.00
		Th2	1.30	3.30	5.40	5.20	.00	.00	.00	.10
NC =100										
	CS=10	Th1	58.10	87.10	96.50	98.40	41.00	74.90	92.20	96.10
		Th2	48.70	85.90	98.90	99.40	32.60	75.30	95.80	98.10
	CS=50	Th1	99.90	100.00	100.00	100.00	98.10	100.00	100.00	100.00
		Th2	98.70	100.00	100.00	100.00	94.50	100.00	100.00	100.00
	CS=100	Th1	99.00	99.80	100.00	100.00	78.20	91.40	94.60	95.50
		Th2	96.50	99.90	100.00	100.00	64.80	86.40	94.30	95.80
Low-ICC										
NC =30										
	CS=10	Th1	11.30	29.70	54.30	69.10	1.80	9.60	23.90	40.60
		Th2	8.60	29.60	58.10	70.40	.60	8.50	28.40	42.00
	CS=50	Th1	72.30	91.50	97.60	98.70	39.00	69.90	85.40	89.50
		Th2	59.20	91.90	97.90	98.70	28.90	69.60	85.10	88.80
	CS=100	Th1	71.90	82.80	88.10	86.80	31.80	43.50	50.00	48.80
		Th2	64.60	81.50	87.90	85.90	25.60	39.10	47.80	50.10
NC =50										
	CS=10	Th1	25.90	56.60	78.30	90.30	9.80	31.20	56.70	74.00
		Th2	17.70	56.40	84.70	90.70	6.30	31.90	64.20	77.40
	CS=50	Th1	97.90	100.00	100.00	100.00	91.40	99.50	100.00	100.00
		Th2	93.00	99.90	100.00	100.00	82.50	99.50	100.00	100.00
	CS=100	Th1	99.70	100.00	100.00	100.00	96.60	98.80	99.80	99.60
		Th2	99.70	100.00	100.00	100.00	93.00	98.60	99.40	99.50
NC =100										
	CS=10	Th1	63.10	90.80	97.90	99.00	47.20	82.50	95.60	97.80
		Th2	52.20	89.90	98.90	99.40	35.80	80.00	96.90	98.50
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-12

CFI Power Rates for the Complex Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	10.40	10.90	11.60	10.80	18.10	18.10	22.50	26.00
		Th2	16.00	10.30	10.60	11.10	21.50	18.40	20.20	20.90
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	8.20	5.00	5.20	5.00	17.00	15.80	19.20	20.80
		Th2	8.80	5.80	4.80	4.80	16.90	16.50	20.20	20.20
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	1.30	.70	.60	.60	9.90	10.80	14.80	17.10
		Th2	2.00	.90	.80	.80	10.80	11.70	16.20	17.50
	CS=50	Th1	.00	.00	.00	.00	.20	.00	.00	.00
		Th2	.00	.00	.00	.00	.20	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	7.20	9.70	11.10	11.40	11.00	17.30	17.90	21.50
		Th2	7.00	8.50	9.50	11.20	11.20	16.00	17.50	21.50
	CS=50	Th1	.30	.10	.00	.00	2.80	1.00	.10	.30
		Th2	.10	.20	.00	.00	2.80	1.00	.30	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	4.20	5.00	5.10	5.20	11.60	14.10	16.10	17.60
		Th2	6.40	5.60	5.50	6.00	10.80	15.50	16.10	18.00
	CS=50	Th1	.00	.00	.00	.00	2.60	1.90	1.20	.50
		Th2	.20	.00	.00	.00	3.00	.80	.70	.70
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	1.60	1.30	.90	.70	8.60	9.10	11.70	13.10
		Th2	1.60	.40	.90	.70	7.70	9.20	12.40	14.00
	CS=50	Th1	.00	.00	.00	.00	2.30	2.80	2.70	2.00
		Th2	.00	.00	.00	.00	3.20	2.30	1.70	2.10
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.10	.00	.00	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-13

TLI Power Rates for the Complex Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	19.90	20.80	24.10	26.60	26.50	30.80	36.30	40.30
		Th2	25.20	20.50	22.10	23.10	29.80	30.30	33.40	38.10
	CS=50	Th1	.00	.00	.00	.00	.10	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	16.80	15.10	16.90	18.60	26.60	30.00	38.00	41.20
		Th2	17.60	16.00	17.10	18.70	26.70	30.40	37.80	42.00
	CS=50	Th1	.00	.00	.00	.00	.30	.00	.00	.00
		Th2	.00	.00	.00	.00	.40	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	7.40	6.20	7.40	8.10	24.40	31.50	42.30	45.80
		Th2	7.70	7.50	8.50	8.40	24.30	32.00	43.90	47.60
	CS=50	Th1	.10	.00	.00	.00	3.40	.10	.20	.00
		Th2	.20	.00	.00	.00	1.90	.20	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	14.00	19.30	20.70	24.60	17.70	25.40	33.10	37.90
		Th2	13.20	17.60	20.40	24.30	15.60	25.00	33.30	37.90
	CS=50	Th1	3.50	1.70	.70	.30	12.40	7.40	5.10	2.40
		Th2	3.70	1.90	.60	.40	11.70	7.00	3.60	2.10
	CS=100	Th1	.00	.00	.00	.00	.30	.00	.00	.00
		Th2	.10	.00	.00	.00	.50	.00	.00	.00
NC =50										
	CS=10	Th1	14.70	15.40	16.10	17.30	23.00	29.70	34.50	37.80
		Th2	12.80	15.90	16.30	17.60	19.20	29.10	35.90	38.90
	CS=50	Th1	2.30	1.50	.80	.50	15.90	16.20	13.20	9.80
		Th2	2.30	.80	.40	.60	13.30	12.90	10.10	8.90
	CS=100	Th1	.10	.00	.00	.00	1.50	.10	.00	.00
		Th2	.00	.00	.00	.00	1.60	.00	.00	.00
NC =100										
	CS=10	Th1	8.90	7.10	7.70	8.20	22.20	27.90	37.30	40.80
		Th2	9.50	7.00	7.60	8.50	20.50	28.90	37.60	43.50
	CS=50	Th1	.30	.30	.00	.00	28.10	34.50	37.80	35.10
		Th2	.40	.10	.10	.10	22.40	35.30	34.60	34.80
	CS=100	Th1	.00	.00	.00	.00	6.10	2.10	1.00	.30
		Th2	.00	.00	.00	.00	7.70	2.70	.40	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-14

RMSEA Power Rates for the Complex Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	.00	.50	2.60	6.00	.00	.00	.00	.00
		Th2	.20	.50	4.30	7.60	.00	.00	.10	.10
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	.00	.00	.30	1.50	.00	.00	.00	.00
		Th2	.00	.10	1.00	2.50	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.10	.00	.00	.00	.00
		Th2	.00	.00	.00	.10	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
Low-ICC										
NC =30										
	CS=10	Th1	.10	.20	3.80	8.60	.00	.00	.10	.20
		Th2	.00	.70	4.00	10.50	.00	.00	.00	.30
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	.00	.10	.50	1.80	.00	.00	.00	.00
		Th2	.00	.10	1.30	2.30	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-15

SRMR-W Power Rates for the Complex Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
NC =30										
	CS=10	Th1	58.90	5.90	.20	.10	21.10	1.10	.30	.10
		Th2	76.00	3.20	.00	.00	49.40	1.50	.30	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =50										
	CS=10	Th1	6.30	.00	.00	.00	.50	.00	.00	.00
		Th2	16.60	.00	.00	.00	5.10	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
NC =100										
	CS=10	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=50	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00
	CS=100	Th1	.00	.00	.00	.00	.00	.00	.00	.00
		Th2	.00	.00	.00	.00	.00	.00	.00	.00

Note. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-16

Rejection Rates (Power) of Chi-Square Test Statistics for the Complex Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	18.50	37.30	59.40	71.40	2.50	9.20	26.50	41.20
		Th2	19.90	35.60	61.20	73.90	3.60	10.20	28.30	41.40
	CS=50	Th1	3.20	2.80	3.10	2.30	0.30	0.10	0.10	0.10
		Th2	2.00	1.80	2.40	2.20	0.00	0.00	0.10	0.10
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	37.20	60.50	83.60	90.60	14.90	35.40	61.70	76.60
		Th2	31.60	63.10	86.40	91.20	11.70	36.20	69.00	79.10
	CS=50	Th1	49.80	61.10	69.50	70.60	13.60	17.30	18.90	19.90
		Th2	37.70	57.00	68.70	70.90	9.60	12.60	18.00	18.40
	CS=100	Th1	4.50	5.30	5.30	5.60	0.00	0.00	0.00	0.00
		Th2	2.70	4.30	5.50	6.00	0.20	0.00	0.00	0.10
NC =100										
	CS=10	Th1	76.30	94.80	98.90	99.80	60.00	88.70	97.30	99.00
		Th2	66.80	94.90	99.60	99.90	49.90	88.90	99.00	99.50
	CS=50	Th1	100.00	100.00	100.00	100.00	99.50	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	98.40	100.00	100.00	100.00
	CS=100	Th1	99.40	100.00	100.00	100.00	87.00	93.90	95.60	97.00
		Th2	99.10	100.00	100.00	100.00	75.30	89.70	96.00	96.70
Low-ICC										
NC =30										
	CS=10	Th1	12.70	32.50	58.10	71.90	1.50	10.00	27.30	43.80
		Th2	8.80	32.30	62.30	73.70	0.70	9.50	30.20	45.00
	CS=50	Th1	76.70	92.40	98.00	99.30	42.40	72.40	86.10	90.30
		Th2	64.10	93.80	98.50	99.00	32.30	71.00	86.10	89.00
	CS=100	Th1	75.70	85.00	89.00	87.70	35.30	45.10	50.40	49.40
		Th2	69.50	83.70	88.50	87.20	27.20	40.30	48.10	50.70
NC =50										
	CS=10	Th1	30.80	62.40	83.60	92.80	11.50	34.30	62.00	79.50
		Th2	20.60	61.10	86.50	92.70	7.00	35.80	69.30	80.50
	CS=50	Th1	99.10	100.00	100.00	100.00	94.00	99.80	100.00	100.00
		Th2	96.10	100.00	100.00	100.00	87.40	99.80	100.00	100.00
	CS=100	Th1	99.90	100.00	100.00	100.00	97.50	98.90	99.80	99.70
		Th2	99.80	100.00	100.00	100.00	94.40	98.90	99.50	99.50
NC =100										
	CS=10	Th1	71.30	94.10	99.10	99.60	54.40	88.60	97.60	98.80
		Th2	59.50	93.50	99.60	99.90	41.80	86.20	98.30	99.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-17

CFI Power Rates for the Complex Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	15.20	13.80	14.60	14.40	22.80	23.00	26.10	28.30
		Th2	20.90	13.90	13.50	14.20	27.20	23.50	24.00	24.70
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	11.80	7.60	8.30	7.30	24.00	22.50	25.30	27.50
		Th2	13.30	9.50	7.50	7.20	23.10	23.40	25.60	27.30
	CS=50	Th1	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	4.30	2.60	1.60	1.60	20.60	22.00	28.00	27.40
		Th2	5.10	2.30	1.70	1.60	20.50	23.00	27.20	29.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	8.50	10.80	12.40	13.60	12.80	18.70	20.40	24.10
		Th2	7.90	9.70	11.30	13.50	11.90	18.10	18.90	23.80
	CS=50	Th1	0.70	0.10	0.00	0.00	3.40	1.00	0.10	0.30
		Th2	0.20	0.20	0.00	0.00	3.30	1.00	0.10	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	6.40	5.70	6.10	6.10	15.10	16.60	18.80	20.60
		Th2	7.60	6.90	6.50	6.90	13.30	17.30	18.80	21.10
	CS=50	Th1	0.00	0.00	0.00	0.00	3.60	2.50	1.20	0.50
		Th2	0.40	0.00	0.00	0.00	4.20	0.90	0.70	0.60
	CS=100	Th1	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
NC =100										
	CS=10	Th1	2.00	1.70	1.00	1.00	10.70	11.70	15.30	16.90
		Th2	2.60	1.00	1.10	1.00	10.20	12.80	16.10	16.80
	CS=50	Th1	0.00	0.00	0.00	0.00	3.90	3.70	4.20	3.10
		Th2	0.00	0.00	0.00	0.00	4.50	3.80	3.10	3.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-18

TLI Power Rates for the Complex Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	24.60	24.80	27.00	30.00	31.00	36.60	40.80	44.40
		Th2	28.60	24.30	25.10	26.30	34.50	34.40	36.30	41.50
	CS=50	Th1	0.10	0.00	0.00	0.00	0.20	0.00	0.00	0.00
		Th2	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	23.90	21.30	22.30	24.70	35.80	39.10	45.20	48.30
		Th2	23.50	22.10	20.80	22.40	33.70	38.90	45.60	49.10
	CS=50	Th1	0.10	0.00	0.00	0.00	0.40	0.00	0.00	0.00
		Th2	0.20	0.00	0.00	0.00	0.60	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	15.70	13.60	12.80	14.20	40.60	47.30	55.60	59.20
		Th2	16.60	14.10	13.70	13.30	37.70	47.00	57.50	61.70
	CS=50	Th1	0.10	0.00	0.00	0.00	4.50	0.50	0.10	0.00
		Th2	0.20	0.00	0.00	0.00	4.00	0.40	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	15.40	20.10	23.00	26.60	19.40	27.30	35.10	40.40
		Th2	13.60	19.80	21.60	26.30	15.10	27.20	34.10	38.80
	CS=50	Th1	4.20	1.70	0.70	0.30	13.40	6.90	4.60	2.50
		Th2	4.10	1.70	0.40	0.40	11.60	6.60	3.20	1.80
	CS=100	Th1	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
		Th2	0.10	0.00	0.00	0.00	0.40	0.00	0.00	0.00
NC =50										
	CS=10	Th1	17.10	17.50	17.00	18.40	25.20	32.00	36.30	41.00
		Th2	14.40	17.80	17.10	19.40	20.90	32.70	38.80	41.90
	CS=50	Th1	2.70	1.60	0.40	0.40	17.00	15.50	12.50	9.20
		Th2	3.60	0.80	0.40	0.80	15.40	13.10	9.60	8.10
	CS=100	Th1	0.10	0.00	0.00	0.00	1.30	0.00	0.00	0.00
		Th2	0.10	0.00	0.00	0.00	1.80	0.00	0.00	0.00
NC =100										
	CS=10	Th1	10.30	8.10	9.00	9.30	25.90	32.30	41.30	45.20
		Th2	10.70	9.40	8.30	9.10	23.50	34.00	41.30	45.70
	CS=50	Th1	0.50	0.30	0.00	0.00	32.20	37.20	38.30	35.80
		Th2	0.50	0.10	0.10	0.10	28.00	37.40	35.40	35.70
	CS=100	Th1	0.00	0.00	0.00	0.00	7.00	1.50	0.30	0.10
		Th2	0.00	0.00	0.00	0.00	8.60	1.80	0.10	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-19

RMSEA Power Rates for the Complex Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	0.00	0.60	2.60	6.90	0.00	0.00	0.00	0.00
		Th2	0.20	0.50	5.10	8.30	0.00	0.00	0.10	0.10
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	0.00	0.10	0.50	2.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.10	1.20	2.80	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	0.20	0.10	4.10	9.20	0.00	0.00	0.10	0.20
		Th2	0.00	0.90	4.50	10.30	0.00	0.00	0.00	0.20
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	0.00	0.10	0.40	2.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.10	1.30	2.20	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-20

Rejection Rates (Power) of Chi-Square Test Statistics for the Simple Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	33.60	43.40	50.60	56.30	9.70	15.70	21.70	27.20
		Th2	31.30	41.70	49.40	54.70	7.80	15.40	20.80	24.30
	CS=50	Th1	8.90	3.10	0.90	0.20	0.70	0.00	0.00	0.00
		Th2	7.40	2.00	0.20	0.00	0.30	0.00	0.00	0.00
	CS=100	Th1	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	60.50	68.60	74.60	77.20	38.20	48.70	56.50	60.40
		Th2	57.20	67.30	74.10	77.70	33.10	45.60	55.40	60.50
	CS=50	Th1	46.60	31.70	19.80	15.10	22.30	9.80	3.10	2.40
		Th2	43.20	26.20	13.30	11.30	19.10	7.20	1.90	1.60
	CS=100	Th1	7.00	1.70	0.40	0.20	0.40	0.00	0.00	0.00
		Th2	5.40	0.80	0.10	0.10	0.30	0.00	0.00	0.00
NC =100										
	CS=10	Th1	91.40	94.30	95.80	96.90	85.10	88.50	91.40	92.00
		Th2	87.80	93.00	95.90	97.00	79.80	87.50	91.30	92.60
	CS=50	Th1	95.00	91.00	86.40	83.10	87.30	79.80	68.70	63.40
		Th2	92.00	88.50	80.70	79.40	85.60	74.20	60.60	58.10
	CS=100	Th1	76.20	54.80	33.30	25.10	46.80	20.70	7.50	4.30
		Th2	74.10	45.20	22.40	19.60	44.00	14.10	3.50	2.30
Low-ICC										
NC =30										
	CS=10	Th1	7.00	14.50	24.50	31.50	0.60	2.50	5.40	8.60
		Th2	4.70	15.40	25.20	31.70	0.50	2.00	6.00	8.00
	CS=50	Th1	33.20	33.90	34.50	36.20	10.70	10.40	9.70	8.90
		Th2	29.80	32.10	33.30	34.20	7.90	10.50	8.00	8.80
	CS=100	Th1	24.70	16.60	11.30	8.90	3.90	1.80	0.60	0.20
		Th2	24.00	15.50	9.40	7.20	4.70	2.10	0.30	0.10
NC =50										
	CS=10	Th1	21.10	33.20	41.80	48.50	8.10	14.10	20.00	26.60
		Th2	15.90	33.30	42.80	49.10	4.50	14.20	21.40	25.20
	CS=50	Th1	63.00	65.00	67.40	70.40	39.60	43.80	46.70	50.00
		Th2	57.30	64.80	66.60	69.50	35.50	42.60	45.30	47.70
	CS=100	Th1	62.20	57.70	53.80	51.00	35.90	28.80	22.90	19.60
		Th2	60.70	57.40	50.40	50.10	36.30	27.80	20.70	19.70
NC =100										
	CS=10	Th1	50.40	60.70	67.30	72.20	33.50	46.30	53.20	56.50
		Th2	46.50	59.00	69.10	72.30	28.40	44.90	53.50	58.10
	CS=50	Th1	91.30	93.10	94.60	95.40	85.40	87.20	90.30	91.50
		Th2	89.60	93.20	94.70	95.40	82.60	88.30	90.30	91.60
	CS=100	Th1	94.90	94.20	93.90	96.00	89.10	89.30	87.80	88.90
		Th2	93.00	94.20	93.60	95.50	89.60	88.10	87.50	89.20

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-21

CFI Power Rates for the Simple Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	29.20	22.60	14.10	9.30	37.20	30.90	23.80	18.50
		Th2	31.10	18.80	10.10	7.00	35.50	27.20	17.60	14.10
	CS=50	Th1	0.40	0.00	0.00	0.00	0.90	0.00	0.00	0.00
		Th2	0.60	0.00	0.00	0.00	0.70	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	37.20	25.40	15.70	11.70	45.20	35.40	27.20	22.80
		Th2	37.10	23.10	11.40	8.70	46.30	33.40	23.40	20.40
	CS=50	Th1	0.70	0.00	0.00	0.00	2.60	0.00	0.00	0.00
		Th2	1.10	0.00	0.00	0.00	2.20	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	46.00	27.20	12.80	8.90	60.00	46.50	32.30	26.40
		Th2	47.40	25.30	9.10	6.90	59.40	43.10	26.80	21.50
	CS=50	Th1	0.10	0.00	0.00	0.00	2.30	0.00	0.00	0.00
		Th2	0.30	0.00	0.00	0.00	3.50	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	5.10	3.50	1.10	0.80	7.30	6.80	4.10	3.40
		Th2	5.30	2.70	1.40	0.80	7.40	6.20	3.60	2.70
	CS=50	Th1	0.20	0.00	0.00	0.00	0.60	0.20	0.00	0.00
		Th2	0.50	0.00	0.00	0.00	1.50	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	4.70	3.00	0.90	0.70	10.30	6.40	4.30	3.90
		Th2	6.60	2.70	0.90	0.60	9.20	6.80	3.00	2.50
	CS=50	Th1	0.10	0.00	0.00	0.00	0.60	0.00	0.00	0.00
		Th2	0.20	0.00	0.00	0.00	0.70	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	3.00	0.90	0.50	0.30	8.10	3.70	1.60	1.20
		Th2	3.30	1.10	0.20	0.10	8.10	3.80	1.50	1.40
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-22

TLI Power Rates for the Simple Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	39.80	34.50	28.10	22.90	44.60	41.90	36.80	33.60
		Th2	40.00	31.60	21.60	18.90	44.60	38.90	30.20	27.40
	CS=50	Th1	1.60	0.00	0.00	0.00	2.70	0.00	0.00	0.00
		Th2	1.40	0.30	0.00	0.00	2.50	0.30	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	49.70	41.60	32.40	28.10	58.10	52.40	45.10	41.00
		Th2	51.00	38.40	26.40	23.70	58.20	49.90	39.80	36.30
	CS=50	Th1	4.20	0.20	0.00	0.00	7.30	0.50	0.00	0.00
		Th2	4.30	0.00	0.00	0.00	7.50	0.10	0.00	0.00
	CS=100	Th1	0.10	0.00	0.00	0.00	0.20	0.00	0.00	0.00
		Th2	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00
NC =100										
	CS=10	Th1	64.90	51.80	38.00	30.80	74.90	66.80	56.80	50.50
		Th2	64.90	50.00	31.60	27.10	74.10	64.00	50.90	47.80
	CS=50	Th1	3.80	0.00	0.00	0.00	12.10	0.40	0.00	0.00
		Th2	5.30	0.00	0.00	0.00	14.00	0.50	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	8.70	8.20	5.90	4.80	11.60	11.70	10.50	9.90
		Th2	8.40	9.10	5.10	4.40	10.00	12.30	8.80	8.50
	CS=50	Th1	0.90	0.30	0.00	0.00	3.70	0.80	0.00	0.00
		Th2	1.90	0.10	0.00	0.00	4.20	0.80	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
NC =50										
	CS=10	Th1	12.40	9.10	5.50	4.80	17.20	15.40	11.40	10.10
		Th2	11.90	8.70	4.00	3.00	16.20	14.20	9.50	9.10
	CS=50	Th1	0.70	0.10	0.00	0.00	3.10	0.30	0.00	0.00
		Th2	1.10	0.20	0.00	0.00	5.40	0.40	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00
		Th2	0.10	0.00	0.00	0.00	0.40	0.00	0.00	0.00
NC =100										
	CS=10	Th1	10.90	5.50	2.40	1.60	17.90	12.70	8.80	6.30
		Th2	10.90	5.00	1.80	1.60	18.20	12.70	7.30	6.40
	CS=50	Th1	0.00	0.00	0.00	0.00	1.90	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	2.60	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-23

RMSEA Power Rates for the Simple Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	1.40	2.10	4.10	5.20	0.00	0.00	0.00	0.00
		Th2	0.70	2.10	4.30	4.40	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	0.30	1.60	3.20	4.40	0.00	0.00	0.00	0.00
		Th2	0.20	1.70	4.10	4.50	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	0.10	0.60	1.40	1.60	0.00	0.00	0.00	0.00
		Th2	0.20	0.60	1.40	1.70	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	0.00	0.00	0.20	0.60	0.00	0.00	0.00	0.00
		Th2	0.00	0.10	0.40	0.30	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.30	0.40	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=50	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-24

SRMR-B Power Rates for the Simple Misspecified Between Level Model

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
NC =30										
	CS=10	Th1	100.00	100.00	99.90	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	99.50	99.70	99.60	99.60	100.00	100.00	100.00	100.00
		Th2	99.80	99.70	99.70	99.70	100.00	100.00	99.90	100.00
	CS=100	Th1	99.60	99.70	99.80	99.80	99.70	100.00	99.80	99.80
		Th2	99.70	99.90	99.90	99.70	99.80	99.70	99.70	99.90
NC =50										
	CS=10	Th1	99.80	99.80	99.60	99.50	100.00	100.00	100.00	100.00
		Th2	100.00	99.90	99.60	99.60	100.00	100.00	100.00	100.00
	CS=50	Th1	98.30	98.20	97.80	97.90	99.60	99.50	99.60	99.20
		Th2	98.30	98.20	97.90	97.90	99.80	99.60	99.20	99.30
	CS=100	Th1	99.00	99.00	98.90	98.90	99.40	99.30	99.10	99.10
		Th2	98.90	98.80	98.90	99.00	99.20	99.00	98.80	98.80
NC =100										
	CS=10	Th1	99.30	99.20	99.20	99.00	100.00	99.90	99.90	99.90
		Th2	99.50	99.20	99.00	99.10	100.00	100.00	99.90	99.90
	CS=50	Th1	98.20	98.30	98.00	98.10	98.60	98.40	98.60	98.30
		Th2	98.20	98.00	98.10	98.00	99.00	98.30	98.10	98.10
	CS=100	Th1	99.40	99.30	99.40	99.50	98.60	98.60	98.30	99.20
		Th2	99.20	99.60	99.70	99.60	98.30	98.60	98.50	99.30

Note. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-25

Rejection Rates (Power) of Chi-Square Test Statistics for the Simple Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	83.70	95.70	99.20	99.90	63.40	88.60	97.60	99.60
		Th2	77.80	96.90	99.80	100.00	53.90	90.90	99.00	99.60
	CS=50	Th1	98.90	99.80	99.80	99.70	91.70	96.50	96.60	96.90
		Th2	97.50	99.70	99.90	99.80	83.40	94.20	96.00	97.10
	CS=100	Th1	88.50	92.70	93.50	92.80	52.40	63.90	65.80	69.20
		Th2	83.40	92.70	93.70	92.20	42.70	62.20	70.70	67.90
NC =50										
	CS=10	Th1	97.80	99.80	100.00	100.00	94.00	99.30	99.90	100.00
		Th2	96.00	100.00	100.00	100.00	89.10	99.80	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	99.80	99.90	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.20	99.90	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	88.80	98.50	100.00	100.00	74.80	95.40	98.70	99.90
		Th2	76.80	98.40	99.80	99.90	53.60	94.80	99.40	99.90
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.20	99.90	100.00	100.00	97.70	99.70	100.00	100.00
		Th2	97.10	100.00	100.00	100.00	92.10	99.90	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-26

CFI Power Rates for the Simple Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	84.00	92.10	97.30	98.90	88.10	94.50	98.30	99.50
		Th2	81.10	93.60	98.30	99.20	84.30	95.90	99.10	99.50
	CS=50	Th1	91.70	94.10	90.90	90.00	92.40	93.70	91.00	89.70
		Th2	85.70	92.80	90.90	88.80	87.20	92.60	90.50	88.80
	CS=100	Th1	59.60	60.60	58.30	58.60	59.40	61.50	59.70	60.80
		Th2	51.80	59.20	60.60	56.60	52.20	59.90	61.60	58.80
NC =50										
	CS=10	Th1	94.40	98.30	99.60	99.90	97.00	99.30	99.90	100.00
		Th2	92.20	99.20	99.80	99.80	95.30	99.80	100.00	100.00
	CS=50	Th1	99.80	100.00	99.80	99.80	99.80	100.00	99.70	99.70
		Th2	99.50	100.00	99.80	99.80	99.80	100.00	99.70	99.60
	CS=100	Th1	96.80	95.30	92.00	90.50	96.10	94.60	91.20	90.90
		Th2	94.40	92.40	92.70	89.50	94.10	91.90	92.40	89.20
NC =100										
	CS=10	Th1	99.20	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	99.20	100.00	100.00	100.00	99.80	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	99.90	100.00	99.90	100.00	99.80
		Th2	100.00	100.00	99.90	99.90	100.00	100.00	99.90	99.80
Low-ICC										
NC =30										
	CS=10	Th1	88.40	97.00	98.80	99.50	90.40	97.70	99.20	99.70
		Th2	79.10	97.00	99.00	99.50	80.40	97.30	99.40	99.70
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	97.70	99.40	99.90	100.00	98.80	99.70	99.90	100.00
		Th2	95.00	99.80	99.90	99.90	96.40	99.90	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	99.80	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	99.80	100.00	100.00	100.00	99.90	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-27

TLI Power Rates for the Simple Misspecified Within Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	89.70	95.40	98.60	99.50	91.00	96.90	99.00	99.80
		Th2	85.90	96.80	99.30	99.60	87.90	97.30	99.70	99.80
	CS=50	Th1	96.20	98.60	96.40	96.20	96.60	98.60	96.40	96.10
		Th2	93.10	96.10	96.90	96.50	93.60	96.10	96.60	96.40
	CS=100	Th1	75.00	74.80	73.60	73.00	74.60	75.70	74.50	74.50
		Th2	68.60	73.70	75.70	72.90	68.40	74.10	76.90	74.80
NC =50										
	CS=10	Th1	97.00	99.40	99.90	100.00	98.20	99.70	99.90	100.00
		Th2	95.90	99.90	100.00	100.00	97.70	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	99.40	99.20	98.60	98.00	99.30	99.00	98.20	97.90
		Th2	98.90	98.60	98.40	98.00	98.50	98.20	98.60	98.30
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	99.90	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	91.60	98.30	99.60	99.90	92.90	98.60	99.60	99.90
		Th2	83.30	98.50	99.80	99.80	84.80	99.00	99.80	99.90
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.20	99.70	100.00	100.00	99.30	99.80	100.00	100.00
		Th2	97.10	99.90	100.00	100.00	97.50	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-28

RMSEA Power Rates for the Simple Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	28.60	67.40	89.90	95.90	2.80	23.70	57.70	76.90
		Th2	22.20	71.00	94.20	97.10	2.60	26.20	69.10	79.30
	CS=50	Th1	0.10	0.80	4.70	7.30	0.00	0.00	0.00	0.00
		Th2	0.00	1.60	4.50	7.40	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	30.20	78.30	97.20	98.90	3.10	27.80	71.10	89.50
		Th2	17.50	80.90	98.00	99.20	1.70	31.30	82.90	91.60
	CS=50	Th1	0.10	5.90	21.30	32.80	0.00	0.00	0.00	0.00
		Th2	0.00	6.00	28.20	37.30	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	23.60	88.20	99.40	99.90	2.00	40.70	88.50	96.30
		Th2	10.70	90.40	99.80	100.00	0.40	45.70	95.30	97.90
	CS=50	Th1	0.50	43.10	85.70	94.20	0.00	0.00	0.10	0.40
		Th2	0.00	41.10	92.90	95.00	0.00	0.00	0.10	0.20
	CS=100	Th1	0.00	0.00	0.30	1.20	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	45.30	83.50	95.80	98.90	6.60	39.20	74.20	85.90
		Th2	25.40	82.00	97.30	98.70	3.10	38.70	80.80	90.10
	CS=50	Th1	70.90	99.50	100.00	100.00	1.50	37.60	85.50	94.30
		Th2	37.10	99.60	100.00	100.00	0.00	34.30	88.70	95.70
	CS=100	Th1	43.40	93.60	98.80	99.00	0.00	0.40	4.40	9.20
		Th2	13.30	90.70	99.70	99.80	0.00	0.30	4.90	11.30
NC =50										
	CS=10	Th1	51.80	91.60	98.40	99.40	8.70	52.00	85.50	94.00
		Th2	28.10	89.30	99.00	99.60	3.40	49.00	90.10	96.10
	CS=50	Th1	81.50	100.00	100.00	100.00	2.70	70.50	98.40	99.70
		Th2	38.50	100.00	100.00	100.00	0.00	65.60	98.60	100.00
	CS=100	Th1	67.80	99.70	100.00	100.00	0.00	4.50	24.00	38.00
		Th2	18.90	99.80	100.00	100.00	0.00	2.60	26.10	39.90
NC =100										
	CS=10	Th1	53.70	96.40	100.00	100.00	10.60	70.40	95.40	99.20
		Th2	24.80	96.30	100.00	100.00	2.30	66.70	98.00	99.60
	CS=50	Th1	93.80	100.00	100.00	100.00	6.20	98.50	100.00	100.00
		Th2	41.90	100.00	100.00	100.00	0.00	97.30	100.00	100.00
	CS=100	Th1	93.70	100.00	100.00	100.00	0.10	49.10	89.70	94.60
		Th2	28.10	100.00	100.00	100.00	0.00	38.50	91.50	96.30

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-29

SRMR-W Power Rates for the Simple Misspecified Within Level Model

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
NC =30										
	CS=10	Th1	98.60	93.60	90.00	89.60	97.80	95.00	90.10	90.60
		Th2	99.00	94.00	88.60	88.10	99.10	95.10	92.00	92.50
	CS=50	Th1	94.90	95.80	96.60	96.30	96.10	95.90	97.10	96.70
		Th2	95.70	96.50	96.30	96.40	95.70	96.60	96.30	96.30
	CS=100	Th1	97.70	98.70	99.40	99.70	98.40	98.80	99.40	99.40
		Th2	98.10	99.20	99.40	99.90	98.30	98.70	99.80	99.70
NC =50										
	CS=10	Th1	97.00	93.90	92.70	92.30	95.20	93.20	91.40	92.00
		Th2	98.30	93.90	90.50	90.30	96.90	92.30	90.90	91.10
	CS=50	Th1	97.60	97.50	98.50	98.80	97.50	97.80	98.70	98.60
		Th2	96.90	97.90	98.30	98.40	97.60	98.50	98.50	98.70
	CS=100	Th1	99.10	99.60	99.90	100.00	99.40	100.00	100.00	100.00
		Th2	99.20	99.70	100.00	99.90	99.30	99.90	100.00	100.00
NC =100										
	CS=10	Th1	95.90	94.10	93.70	94.00	95.70	93.70	92.50	93.60
		Th2	96.40	93.90	93.30	93.50	95.00	94.10	93.90	93.60
	CS=50	Th1	99.10	99.30	99.50	99.60	99.40	99.70	99.80	99.90
		Th2	98.50	99.20	99.70	99.60	99.30	100.00	99.90	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	99.70	100.00	100.00	100.00	99.90	100.00	100.00	100.00

Note. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-30

Rejection Rates (Power) of Chi-Square Test Statistics for the Simple Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	90.10	97.70	99.80	99.90	71.20	92.20	98.60	99.50
		Th2	85.60	98.20	99.90	100.00	61.90	93.30	99.30	99.80
	CS=50	Th1	99.70	100.00	99.90	99.90	94.90	98.20	97.40	97.70
		Th2	99.00	99.70	100.00	99.80	89.10	96.50	97.60	97.80
	CS=100	Th1	93.50	95.10	94.50	94.30	61.80	68.10	69.30	70.50
		Th2	89.90	95.00	95.00	92.80	49.60	64.70	72.20	69.10
NC =50										
	CS=10	Th1	99.80	99.90	100.00	100.00	97.20	99.90	100.00	100.00
		Th2	98.20	100.00	100.00	100.00	93.60	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	99.80	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	88.60	98.90	100.00	100.00	71.80	94.60	98.50	99.90
		Th2	73.80	98.40	99.80	100.00	49.60	93.50	99.40	99.80
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.10	100.00	100.00	100.00	97.50	99.90	100.00	100.00
		Th2	97.20	100.00	100.00	100.00	92.40	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-31

CFI Power Rates for the Simple Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	89.80	96.00	98.40	99.10	92.50	97.10	99.00	99.50
		Th2	88.90	96.20	98.60	99.40	89.90	96.90	99.50	99.80
	CS=50	Th1	95.20	95.70	92.10	90.90	95.90	96.20	92.80	91.70
		Th2	90.10	94.20	92.30	89.50	92.40	94.80	92.70	90.00
	CS=100	Th1	67.60	64.40	60.00	60.20	69.20	66.70	62.30	62.80
		Th2	60.80	62.60	61.50	58.20	62.70	65.10	64.60	61.20
NC =50										
	CS=10	Th1	98.60	99.50	99.90	99.90	99.20	99.90	100.00	100.00
		Th2	97.00	99.90	99.90	99.90	97.70	99.90	99.90	100.00
	CS=50	Th1	99.90	100.00	99.90	99.70	99.90	100.00	99.80	99.70
		Th2	99.80	100.00	99.80	99.70	99.90	100.00	99.70	99.70
	CS=100	Th1	97.60	96.00	92.00	90.60	97.60	96.30	92.60	91.70
		Th2	96.20	93.10	92.70	90.00	96.30	93.50	93.30	91.20
NC =100										
	CS=10	Th1	99.90	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	99.90	100.00	100.00	100.00	99.90
		Th2	100.00	100.00	99.80	99.80	100.00	100.00	99.90	99.80
Low-ICC										
NC =30										
	CS=10	Th1	88.20	97.10	98.50	99.40	89.90	97.70	99.00	99.80
		Th2	77.10	96.70	99.10	99.50	79.20	97.80	99.50	99.70
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	99.90	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	97.70	99.40	99.80	100.00	98.50	99.70	99.90	100.00
		Th2	96.00	99.90	99.90	99.90	96.60	99.90	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	99.90	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-32

TLI Power Rates for the Simple Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	93.50	97.70	99.50	99.80	94.80	98.30	99.60	99.90
		Th2	91.20	98.00	99.70	99.80	92.60	98.60	99.80	99.90
	CS=50	Th1	97.80	99.00	97.20	96.80	98.20	99.10	97.50	97.20
		Th2	96.50	97.80	97.40	97.10	97.00	97.90	97.60	97.00
	CS=100	Th1	80.90	79.10	74.80	73.90	81.50	80.30	76.40	75.90
		Th2	76.80	76.80	76.70	74.10	77.70	78.80	78.10	76.50
NC =50										
	CS=10	Th1	99.80	99.90	100.00	100.00	99.80	99.90	100.00	100.00
		Th2	98.50	99.90	100.00	100.00	98.90	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	99.80	99.30	98.90	98.40	99.80	99.40	98.80	98.40
		Th2	99.70	99.10	99.20	97.90	99.70	99.10	99.30	98.50
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Low-ICC										
NC =30										
	CS=10	Th1	91.90	98.50	99.50	99.90	92.90	99.00	99.50	99.90
		Th2	82.40	98.20	99.70	99.70	83.40	98.40	99.70	99.90
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =50										
	CS=10	Th1	99.10	100.00	100.00	100.00	99.40	100.00	100.00	100.00
		Th2	97.30	100.00	100.00	100.00	97.90	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
NC =100										
	CS=10	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=50	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	CS=100	Th1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Th2	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

Table A-33

RMSEA Power Rates for the Simple Misspecified Between- and Within-Level Models

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC =30										
	CS=10	Th1	35.80	71.80	92.00	96.70	1.60	18.90	52.40	72.50
		Th2	25.80	74.50	94.70	97.70	1.00	20.70	63.40	77.10
	CS=50	Th1	0.00	0.70	3.00	5.40	0.00	0.00	0.00	0.00
		Th2	0.00	0.70	3.00	5.50	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =50										
	CS=10	Th1	39.00	84.00	97.50	99.40	1.90	20.40	60.90	84.00
		Th2	25.50	83.20	98.50	99.50	1.00	22.80	74.80	87.60
	CS=50	Th1	0.00	2.30	13.80	22.70	0.00	0.00	0.00	0.00
		Th2	0.00	1.70	18.90	26.40	0.00	0.00	0.00	0.00
	CS=100	Th1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC =100										
	CS=10	Th1	40.00	93.90	99.50	100.00	0.60	24.60	78.40	93.00
		Th2	24.70	94.40	99.90	100.00	0.10	30.80	90.50	95.70
	CS=50	Th1	0.00	19.50	72.80	85.20	0.00	0.00	0.00	0.00
		Th2	0.00	20.50	83.50	89.10	0.00	0.00	0.00	0.10
	CS=100	Th1	0.00	0.00	0.10	0.40	0.00	0.00	0.00	0.00
		Th2	0.00	0.00	0.40	0.50	0.00	0.00	0.00	0.00
Low-ICC										
NC =30										
	CS=10	Th1	37.90	78.80	94.20	98.70	2.70	25.90	64.70	80.40
		Th2	21.10	77.20	96.30	98.40	1.00	25.30	71.20	83.20
	CS=50	Th1	52.50	98.00	100.00	100.00	0.00	12.30	66.30	86.20
		Th2	20.90	98.10	100.00	100.00	0.00	9.80	71.70	89.30
	CS=100	Th1	17.10	82.50	97.50	98.80	0.00	0.00	1.70	5.00
		Th2	3.60	78.20	97.60	99.50	0.00	0.00	2.30	5.60
NC =50										
	CS=10	Th1	45.10	88.60	98.10	99.20	3.30	32.90	73.50	89.20
		Th2	23.30	86.60	99.00	99.50	1.50	31.30	81.50	90.80
	CS=50	Th1	59.60	99.90	100.00	100.00	0.00	19.40	85.80	96.70
		Th2	16.80	99.60	100.00	100.00	0.00	18.40	89.80	97.70
	CS=100	Th1	25.90	97.90	100.00	100.00	0.00	0.30	7.70	18.70
		Th2	3.30	97.40	100.00	100.00	0.00	0.20	8.90	20.00
NC =100										
	CS=10	Th1	45.60	95.40	99.90	100.00	2.10	41.10	84.90	95.50
		Th2	18.60	93.70	100.00	100.00	0.40	39.30	91.90	97.00
	CS=50	Th1	66.80	100.00	100.00	100.00	0.00	36.10	98.00	100.00
		Th2	11.10	100.00	100.00	100.00	0.00	31.90	99.70	100.00
	CS=100	Th1	41.40	100.00	100.00	100.00	0.00	1.90	42.10	68.50
		Th2	1.80	100.00	100.00	100.00	0.00	1.00	53.30	72.70

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation. Low ICC = Low Intra-Class Correlation. NC = Number of Clusters. CS = Cluster Size. Th1 = Balanced Threshold Structure. Th2 = Skewed Threshold Structure. –cat = number of categories.

APPENDIX B

MEANS AND STANDARD DEVIATIONS OF CHI-SQUARE, CFI, TLI, RMSEA, SRMR-W, AND SRMR-B

Means and standard deviations of chi-square, CFI, TLI, and RMSEA were provided across EST, ICC, CAT, NC, CS, and TH under seven different (i.e., correct model, MBc, MWc, MWBc, MBs, MWs, MWBs) model specification conditions. Means and standard deviation of SRMR-W and SRMR-B were provided by ICC, CAT, NC, CS, and TH because both WLSM and WLSMV resulted in exactly same estimates for SRMR-W and SRMR-B across other simulation conditions.

Table B-1

Chi-Square Means and Standard Deviations (in parenthesis) for the Correct Model by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	60.51 (12.57)	64.26 (13.55)	65.60 (14.73)	68.76 (15.78)	62.16 (6.61)	63.08 (7.10)	64.84 (7.72)	66.51 (8.27)
		Th2	60.76 (13.82)	61.89 (12.94)	64.47 (14.56)	67.52 (15.03)	62.32 (7.12)	62.90 (6.75)	64.25 (7.60)	65.85 (7.85)
	CS=50	Th1	31.02 (8.58)	23.37 (7.16)	18.31 (6.00)	16.12 (5.38)	51.23 (3.01)	49.80 (2.23)	48.83 (1.79)	48.34 (1.63)
		Th2	31.45 (8.79)	21.60 (6.83)	15.98 (5.44)	14.89 (5.22)	51.33 (3.07)	49.46 (2.00)	48.37 (1.64)	48.09 (1.58)
	CS=100	Th1	12.84 (4.23)	8.47 (3.09)	6.13 (2.39)	5.22 (2.12)	48.49 (1.45)	47.79 (1.29)	47.15 (1.19)	46.65 (1.17)
		Th2	13.16 (4.40)	7.79 (2.94)	5.22 (2.08)	4.74 (1.94)	48.58 (1.53)	47.69 (1.24)	46.88 (1.19)	46.53 (1.14)
NC=50										
	CS=10	Th1	62.39 (13.00)	63.59 (13.29)	66.01 (14.51)	68.30 (14.99)	63.01 (7.96)	63.74 (8.09)	65.21 (8.83)	66.61 (9.12)
		Th2	62.48 (13.13)	63.45 (13.81)	65.63 (14.63)	68.17 (14.97)	63.07 (7.91)	63.65 (8.36)	64.98 (8.87)	66.52 (9.07)
	CS=50	Th1	38.95 (9.38)	30.90 (7.84)	25.31 (7.07)	23.13 (6.50)	52.42 (4.19)	50.55 (3.00)	49.48 (2.51)	49.09 (2.22)
		Th2	38.89 (9.60)	28.84 (7.27)	22.37 (6.19)	21.43 (6.04)	52.37 (4.27)	50.04 (2.73)	48.78 (2.12)	48.68 (2.07)
	CS=100	Th1	18.31 (5.42)	12.39 (3.84)	9.32 (3.00)	8.19 (2.72)	48.76 (1.77)	47.83 (1.42)	47.25 (1.23)	46.89 (1.19)
		Th2	18.44 (5.24)	11.53 (3.64)	8.16 (2.72)	7.57 (2.60)	48.76 (1.76)	47.70 (1.33)	46.97 (1.21)	46.76 (1.19)
NC=100										
	CS=10	Th1	63.92 (12.47)	64.26 (13.66)	65.71 (14.12)	67.07 (14.37)	63.94 (8.89)	64.18 (9.69)	65.20 (9.98)	66.16 (10.14)
		Th2	63.68 (12.90)	64.21 (13.04)	65.43 (14.32)	66.86 (14.59)	63.76 (9.10)	64.14 (9.20)	64.99 (10.07)	66.00 (10.26)
	CS=50	Th1	48.45 (10.33)	41.39 (9.05)	35.57 (8.10)	33.39 (7.90)	54.89 (6.06)	52.47 (4.57)	50.88 (3.66)	50.44 (3.41)
		Th2	48.29 (10.21)	39.17 (8.87)	32.54 (7.50)	31.57 (7.39)	54.77 (6.01)	51.71 (4.36)	50.08 (3.29)	50.00 (3.12)
	CS=100	Th1	27.01 (6.65)	19.99 (5.06)	15.84 (4.16)	14.15 (3.76)	49.55 (2.48)	48.44 (1.79)	47.82 (1.51)	47.49 (1.36)
		Th2	27.54 (6.45)	18.61 (4.86)	13.86 (3.84)	13.12 (3.69)	49.59 (2.49)	48.25 (1.68)	47.46 (1.37)	47.33 (1.37)
Low-ICC										
NC=30										
	CS=10	Th1	55.28 (13.67)	60.63 (13.68)	65.08 (14.92)	69.94 (16.70)	59.83 (6.68)	62.41 (6.98)	64.67 (7.69)	67.22 (8.67)
		Th2	52.75 (14.32)	60.42 (14.40)	66.24 (15.40)	70.66 (16.26)	58.79 (6.79)	62.34 (7.26)	65.28 (7.92)	67.61 (8.44)
	CS=50	Th1	56.76 (12.64)	55.39 (12.55)	54.70 (13.60)	55.68 (13.44)	60.30 (6.49)	59.81 (6.12)	59.74 (6.36)	60.29 (6.19)
		Th2	56.81 (12.54)	54.70 (12.58)	53.71 (13.03)	54.74 (13.48)	60.32 (6.44)	59.50 (6.15)	59.93 (6.01)	59.90 (6.12)

Table B-1 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	43.98 (10.47)	37.90 (9.75)	34.06 (9.04)	32.21 (9.09)	55.53 (4.38)	54.03 (3.56)	53.26 (3.02)	52.87 (2.92)
		Th2	45.76 (11.09)	37.26 (9.61)	32.35 (8.83)	31.29 (21.01)	56.16 (4.72)	53.92 (3.40)	52.91 (2.80)	52.66 (3.15)
NC=50										
	CS=10	Th1	60.73 (12.74)	63.88 (13.12)	66.62 (13.91)	70.29 (14.49)	62.07 (7.72)	63.90 (8.04)	65.62 (8.47)	67.86 (8.85)
		Th2	59.14 (12.92)	63.97 (13.53)	67.23 (14.27)	70.10 (15.02)	61.25 (7.64)	64.01 (8.21)	65.98 (8.69)	67.75 (9.15)
	CS=50	Th1	59.29 (12.66)	58.49 (12.64)	58.04 (12.81)	59.39 (13.22)	61.16 (7.66)	60.80 (7.40)	60.72 (7.25)	61.55 (7.29)
		Th2	59.23 (12.51)	57.84 (12.83)	56.94 (12.56)	58.27 (13.02)	61.14 (7.56)	60.45 (7.47)	60.16 (6.98)	60.95 (7.13)
	CS=100	Th1	49.35 (10.75)	43.83 (10.43)	40.64 (10.07)	39.46 (9.99)	56.60 (5.42)	54.94 (4.58)	54.29 (4.07)	54.14 (3.85)
		Th2	50.83 (11.36)	43.29 (9.95)	39.01 (9.65)	38.65 (9.70)	57.24 (5.89)	54.75 (4.40)	53.85 (3.81)	53.95 (3.74)
NC=100										
	CS=10	Th1	63.34 (12.39)	64.64 (13.62)	65.89 (13.92)	67.40 (14.08)	63.51 (8.95)	64.45 (8.04)	65.33 (9.90)	66.40 (10.01)
		Th2	63.17 (12.46)	64.42 (13.70)	65.85 (13.70)	67.41 (14.30)	63.41 (8.93)	64.29 (9.77)	65.30 (9.72)	66.41 (10.14)
	CS=50	Th1	61.55 (12.33)	58.49 (12.64)	60.20 (12.51)	60.74 (12.71)	62.26 (8.74)	61.74 (8.79)	61.44 (8.51)	61.86 (8.53)
		Th2	61.06 (12.85)	60.57 (12.97)	59.64 (12.83)	60.39 (12.84)	61.91 (9.11)	61.65 (8.98)	61.11 (8.63)	61.64 (8.56)
	CS=100	Th1	54.63 (11.40)	50.81 (11.39)	48.02 (10.91)	47.32 (10.34)	58.13 (7.24)	56.51 (6.54)	55.72 (5.70)	55.72 (5.17)
		Th2	55.48 (11.75)	49.94 (11.28)	46.47 (10.85)	46.62 (10.36)	58.57 (7.59)	56.16 (6.35)	55.19 (5.49)	55.52 (5.11)

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-2

CFI Means and Standard Deviations (in parenthesis) for the Correct Model by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.992 (0.015)	0.994 (0.012)	0.994 (0.010)	0.993 (0.010)	0.990 (0.020)	0.991 (0.015)	0.992 (0.013)	0.991 (0.013)
		Th2	0.990 (0.021)	0.994 (0.011)	0.995 (0.009)	0.994 (0.009)	0.987 (0.026)	0.992 (0.014)	0.993 (0.012)	0.992 (0.012)
	CS=50	Th1	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
		Th2	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
	CS=100	Th1	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
		Th2	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
NC=50										
	CS=10	Th1	0.994 (0.011)	0.996 (0.008)	0.996 (0.006)	0.996 (0.006)	0.992 (0.015)	0.994 (0.011)	0.994 (0.009)	0.994 (0.009)
		Th2	0.993 (0.012)	0.996 (0.007)	0.997 (0.005)	0.996 (0.005)	0.990 (0.017)	0.994 (0.011)	0.995 (0.008)	0.994 (0.008)
	CS=50	Th1	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)
		Th2	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	0.999 (0.001)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
	CS=100	Th1	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
		Th2	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
NC=100										
	CS=10	Th1	0.997 (0.005)	0.998 (0.004)	0.998 (0.003)	0.998 (0.003)	0.995 (0.008)	0.996 (0.006)	0.997 (0.005)	0.997 (0.005)
		Th2	0.996 (0.006)	0.998 (0.004)	0.998 (0.003)	0.998 (0.003)	0.995 (0.009)	0.997 (0.001)	0.997 (0.005)	0.997 (0.004)
	CS=50	Th1	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)	0.999 (0.001)
	CS=100	Th1	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
		Th2	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
Low-ICC										
NC=30										
	CS=10	Th1	0.995 (0.012)	0.995 (0.010)	0.994 (0.009)	0.993 (0.010)	0.994 (0.015)	0.994 (0.013)	0.993 (0.012)	0.991 (0.013)
		Th2	0.995 (0.014)	0.995 (0.010)	0.994 (0.009)	0.993 (0.009)	0.994 (0.018)	0.993 (0.013)	0.992 (0.012)	0.991 (0.012)
	CS=50	Th1	0.999 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.003)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)
		Th2	0.999 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.998 (0.004)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)

Table B-2 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	1.000 (0.000)
		Th2	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
NC=50										
	CS=10	Th1	0.996 (0.009)	0.996 (0.007)	0.996 (0.006)	0.995 (0.006)	0.994 (0.012)	0.994 (0.001)	0.995 (0.008)	0.994 (0.008)
		Th2	0.995 (0.010)	0.996 (0.007)	0.996 (0.006)	0.996 (0.006)	0.994 (0.012)	0.994 (0.009)	0.995 (0.008)	0.994 (0.008)
	CS=50	Th1	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)
	CS=100	Th1	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
NC=100										
	CS=10	Th1	0.997 (0.005)	0.998 (0.004)	0.998 (0.003)	0.998 (0.003)	0.996 (0.006)	0.997 (0.005)	0.997 (0.005)	0.997 (0.004)
		Th2	0.997 (0.006)	0.998 (0.004)	0.998 (0.003)	0.998 (0.003)	0.995 (0.008))	0.997 (0.005)	0.997 (0.004)	0.997 (0.004)
	CS=50	Th1	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
	CS=100	Th1	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-3

TLI Means and Standard Deviations (in parenthesis) for the Correct Model by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	1.013 (0.042)	1.004 (0.029)	0.998 (0.021)	0.995 (0.019)	1.016 (0.054)	1.006 (0.038)	0.998 (0.028)	0.993 (0.025)
		Th2	1.014 (0.054)	1.005 (0.026)	1.000 (0.018)	0.996 (0.017)	1.018 (0.068)	1.006 (0.035)	0.999 (0.025)	0.995 (0.022)
	CS=50	Th1	1.040 (0.015)	1.036 (0.011)	1.033 (0.010)	1.033 (0.010)	1.042 (0.015)	1.037 (0.011)	1.033 (0.010)	1.033 (0.010)
		Th2	1.045 (0.017)	1.038 (0.012)	1.033 (0.010)	1.033 (0.010)	1.047 (0.018)	1.038 (0.012)	1.033 (0.010)	1.033 (0.010)
	CS=100	Th1	1.064 (0.018)	1.056 (0.018)	1.052 (0.017)	1.052 (0.017)	1.063 (0.018)	1.057 (0.018)	1.053 (0.018)	1.054 (0.019)
		Th2	1.071 (0.020)	1.058 (0.019)	1.051 (0.019)	1.052 (0.019)	1.070 (0.019)	1.059 (0.019)	1.053 (0.020)	1.054 (0.020)
NC=50										
	CS=10	Th1	1.003 (0.026)	1.001 (0.017)	0.998 (0.013)	0.997 (0.011)	1.005 (0.035)	1.001 (0.023)	0.998 (0.018)	0.996 (0.016)
		Th2	1.004 (0.029)	1.001 (0.017)	0.999 (0.011)	0.997 (0.010)	1.005 (0.039)	1.001 (0.024)	0.998 (0.017)	0.996 (0.015)
	CS=50	Th1	1.015 (0.007)	1.015 (0.004)	1.014 (0.004)	1.013 (0.003)	1.017 (0.007)	1.015 (0.005)	1.014 (0.004)	1.013 (0.003)
		Th2	1.017 (0.008)	1.015 (0.004)	1.013 (0.003)	1.013 (0.003)	1.020 (0.008)	1.016 (0.004)	1.013 (0.003)	1.013 (0.003)
	CS=100	Th1	1.025 (0.006)	1.022 (0.005)	1.020 (0.005)	1.019 (0.005)	1.025 (0.006)	1.022 (0.005)	1.020 (0.005)	1.020 (0.005)
		Th2	1.028 (0.007)	1.023 (0.006)	1.019 (0.005)	1.019 (0.005)	1.028 (0.007)	1.023 (0.006)	1.020 (0.005)	1.019 (0.005)
NC=100										
	CS=10	Th1	1.000 (0.012)	1.000 (0.009)	0.999 (0.006)	0.999 (0.006)	1.000 (0.017)	1.000 (0.013)	0.999 (0.010)	0.998 (0.009)
		Th2	1.001 (0.014)	1.000 (0.008)	0.999 (0.006)	0.999 (0.005)	1.001 (0.020)	1.000 (0.012)	0.999 (0.009)	0.998 (0.009)
	CS=50	Th1	1.004 (0.003)	1.004 (0.002)	1.004 (0.001)	1.004 (0.001)	1.005 (0.004)	1.005 (0.002)	1.004 (0.001)	1.004 (0.001)
		Th2	1.005 (0.003)	1.004 (0.002)	1.004 (0.001)	1.004 (0.001)	1.006 (0.004)	1.005 (0.002)	1.004 (0.001)	1.004 (0.001)
	CS=100	Th1	1.008 (0.002)	1.007 (0.001)	1.006 (0.001)	1.006 (0.001)	1.008 (0.002)	1.006 (0.001)	1.006 (0.001)	1.005 (0.001)
		Th2	1.008 (0.002)	1.007 (0.001)	1.006 (0.001)	1.006 (0.001)	1.008 (0.002)	1.007 (0.001)	1.006 (0.001)	1.005 (0.001)
Low-ICC										
NC=30										
	CS=10	Th1	1.029 (0.046)	1.007 (0.027)	0.999 (0.020)	0.994 (0.018)	1.033 (0.053)	1.008 (0.033)	0.998 (0.025)	0.992 (0.023)
		Th2	1.046 (0.061)	1.007 (0.028)	0.998 (0.018)	0.993 (0.017)	1.051 (0.068)	1.008 (0.034)	0.996 (0.023)	0.991 (0.021)
	CS=50	Th1	1.005 (0.008)	1.004 (0.005)	1.003 (0.004)	1.002 (0.004)	1.006 (0.011)	1.005 (0.007)	1.004 (0.005)	1.003 (0.004)
		Th2	1.006 (0.010)	1.004 (0.005)	1.003 (0.004)	1.002 (0.004)	1.007 (0.013)	1.005 (0.007)	1.004 (0.005)	1.003 (0.004)

Table B-3 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	1.009 (0.005)	1.008 (0.003)	1.007 (0.003)	1.007 (0.003)	1.010 (0.005)	1.008 (0.003)	1.007 (0.003)	1.007 (0.003)
		Th2	1.009 (0.006)	1.008 (0.004)	1.007 (0.003)	1.007 (0.003)	1.010 (0.007)	1.008 (0.004)	1.007 (0.003)	1.007 (0.003)
NC=50										
	CS=10	Th1	1.006 (0.024)	1.000 (0.015)	0.998 (0.012)	0.996 (0.010)	1.008 (0.030)	1.000 (0.021)	0.997 (0.016)	0.994 (0.014)
		Th2	1.012 (0.029)	1.000 (0.016)	0.998 (0.011)	0.996 (0.010)	1.014 (0.036)	1.000 (0.021)	0.997 (0.015)	0.994 (0.014)
	CS=50	Th1	1.002 (0.005)	1.001 (0.003)	1.001 (0.002)	1.001 (0.002)	1.003 (0.007)	1.002 (0.004)	1.001 (0.003)	1.001 (0.003)
		Th2	1.002 (0.006)	1.002 (0.003)	1.001 (0.002)	1.001 (0.002)	1.003 (0.008)	1.002 (0.004)	1.002 (0.003)	1.001 (0.003)
	CS=100	Th1	1.003 (0.003)	1.003 (0.002)	1.003 (0.001)	1.003 (0.001)	1.004 (0.003)	1.004 (0.002)	1.003 (0.001)	1.003 (0.001)
		Th2	1.004 (0.003)	1.003 (0.002)	1.003 (0.001)	1.003 (0.001)	1.004 (0.004)	1.004 (0.002)	1.003 (0.001)	1.003 (0.001)
NC=100										
	CS=10	Th1	1.001 (0.011)	1.000 (0.008)	0.999 (0.006)	0.999 (0.005)	1.001 (0.015)	1.000 (0.011)	0.999 (0.009)	0.998 (0.008)
		Th2	1.001 (0.014)	1.000 (0.008)	0.999 (0.006)	0.999 (0.005)	1.001 (0.018)	1.000 (0.011)	0.999 (0.008)	0.998 (0.008)
	CS=50	Th1	1.001 (0.002)	1.000 (0.002)	1.000 (0.001)	1.000 (0.001)	1.001 (0.003)	1.001 (0.002)	1.001 (0.002)	1.000 (0.002)
		Th2	1.001 (0.003)	1.000 (0.002)	1.000 (0.001)	1.000 (0.001)	1.001 (0.004)	1.001 (0.002)	1.001 (0.002)	1.000 (0.001)
	CS=100	Th1	1.001 (0.001)	1.001 (0.001)	1.001 (0.001)	1.001 (0.001)	1.001 (0.002)	1.001 (0.001)	1.001 (0.001)	1.001 (0.001)
		Th2	1.001 (0.002)	1.001 (0.001)	1.001 (0.001)	1.001 (0.001)	1.002 (0.002)	1.001 (0.001)	1.001 (0.001)	1.001 (0.001)

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-4

RMSEA Means and Standard Deviations (in parenthesis) for the Correct Model by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.007 (0.011)	0.009 (0.012)	0.012 (0.014)	0.015 (0.015)	0.005 (0.008)	0.007 (0.009)	0.009 (0.01)	0.011 (0.011)
		Th2	0.008 (0.012)	0.008 (0.012)	0.011 (0.014)	0.014 (0.015)	0.006 (0.009)	0.006 (0.009)	0.008 (0.01)	0.010 (0.011)
	CS=50	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.007 (0.010)	0.008 (0.010)	0.010 (0.011)	0.011 (0.011)	0.005 (0.007)	0.006 (0.008)	0.007 (0.009)	0.009 (0.009)
		Th2	0.007 (0.010)	0.008 (0.010)	0.009 (0.011)	0.011 (0.011)	0.005 (0.007)	0.006 (0.008)	0.007 (0.008)	0.009 (0.009)
	CS=50	Th1	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=100										
	CS=10	Th1	0.006 (0.007)	0.006 (0.007)	0.007 (0.008)	0.007 (0.008)	0.005 (0.006)	0.005 (0.006)	0.006 (0.006)	0.006 (0.007)
		Th2	0.005 (0.007)	0.006 (0.007)	0.006 (0.008)	0.007 (0.008)	0.005 (0.006)	0.005 (0.006)	0.005 (0.006)	0.006 (0.007)
	CS=50	Th1	0 (0.001)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Low-ICC										
NC=30										
	CS=10	Th1	0.005 (0.010)	0.008 (0.012)	0.012 (0.014)	0.016 (0.016)	0.004 (0.007)	0.006 (0.009)	0.008 (0.010)	0.012 (0.011)
		Th2	0.004 (0.009)	0.008 (0.012)	0.013 (0.014)	0.017 (0.016)	0.003 (0.007)	0.006 (0.009)	0.009 (0.010)	0.012 (0.011)
	CS=50	Th1	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.003)	0.001 (0.003)	0.001 (0.003)	0.002 (0.003)
		Th2	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)

Table B-4 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.001)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.006 (0.009)	0.008 (0.010)	0.010 (0.011)	0.013 (0.011)	0.005 (0.007)	0.006 (0.008)	0.008 (0.008)	0.010 (0.009)
		Th2	0.005 (0.009)	0.008 (0.010)	0.010 (0.011)	0.013 (0.012)	0.004 (0.007)	0.006 (0.008)	0.008 (0.009)	0.010 (0.009)
	CS=50	Th1	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)
		Th2	0.002 (0.004)	0.002 (0.004)	0.002 (0.003)	0.002 (0.004)	0.002 (0.003)	0.002 (0.003)	0.001 (0.003)	0.002 (0.003)
	CS=100	Th1	0 (0.001)	0 (0.001)	0 (0.001)	0 (0)	0 (0.001)	0 (0.001)	0 (0)	0 (0)
		Th2	0.001 (0.002)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
NC=100										
	CS=10	Th1	0.005 (0.007)	0.006 (0.007)	0.007 (0.008)	0.007 (0.008)	0.004 (0.006)	0.005 (0.006)	0.005 (0.006)	0.006 (0.007)
		Th2	0.005 (0.007)	0.006 (0.007)	0.006 (0.008)	0.007 (0.008)	0.004 (0.006)	0.005 (0.006)	0.005 (0.006)	0.006 (0.007)
	CS=50	Th1	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.002 (0.002)
		Th2	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)
	CS=100	Th1	0.001 (0.001)	0 (0.001)	0 (0.001)	0 (0.001)	0.001 (0.001)	0 (0.001)	0 (0.001)	0 (0.001)
		Th2	0.001 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)	0.001 (0.001)	0 (0.001)	0 (0.001)	0 (0.001)

Note. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-5

SRMR Means and Standard Deviations (in parenthesis) for the Correct Model by ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
SRMR-Within										
NC=30										
	CS=10	Th1	0.074 (0.010)	0.056 (0.008)	0.046 (0.006)	0.043 (0.006)	0.064 (0.008)	0.050 (0.006)	0.042 (0.006)	0.039 (0.005)
		Th2	0.081 (0.012)	0.054 (0.007)	0.042 (0.006)	0.041 (0.006)	0.072 (0.011)	0.050 (0.007)	0.040 (0.006)	0.039 (0.005)
	CS=50	Th1	0.032 (0.004)	0.025 (0.003)	0.021 (0.003)	0.019 (0.003)	0.027 (0.004)	0.021 (0.003)	0.018 (0.002)	0.017 (0.002)
		Th2	0.035 (0.005)	0.024 (0.003)	0.019 (0.003)	0.019 (0.003)	0.030 (0.004)	0.021 (0.003)	0.017 (0.002)	0.017 (0.002)
	CS=100	Th1	0.024 (0.003)	0.018 (0.003)	0.015 (0.002)	0.014 (0.002)	0.020 (0.003)	0.015 (0.002)	0.013 (0.002)	0.013 (0.002)
		Th2	0.026 (0.004)	0.018 (0.003)	0.014 (0.002)	0.014 (0.002)	0.022 (0.003)	0.015 (0.002)	0.013 (0.002)	0.012 (0.002)
NC=50										
	CS=10	Th1	0.057 (0.007)	0.043 (0.005)	0.035 (0.005)	0.033 (0.004)	0.049 (0.007)	0.038 (0.005)	0.032 (0.004)	0.030 (0.004)
		Th2	0.062 (0.008)	0.042 (0.006)	0.033 (0.004)	0.031 (0.004)	0.055 (0.007)	0.038 (0.005)	0.031 (0.004)	0.029 (0.004)
	CS=50	Th1	0.025 (0.003)	0.019 (0.003)	0.016 (0.002)	0.015 (0.002)	0.021 (0.003)	0.016 (0.002)	0.014 (0.002)	0.013 (0.002)
		Th2	0.027 (0.004)	0.018 (0.002)	0.015 (0.002)	0.014 (0.002)	0.023 (0.003)	0.016 (0.002)	0.013 (0.002)	0.013 (0.002)
	CS=100	Th1	0.018 (0.002)	0.014 (0.002)	0.012 (0.002)	0.011 (0.002)	0.015 (0.002)	0.012 (0.002)	0.010 (0.001)	0.009 (0.001)
		Th2	0.020 (0.003)	0.014 (0.002)	0.011 (0.002)	0.010 (0.001)	0.017 (0.002)	0.012 (0.002)	0.010 (0.001)	0.009 (0.001)
NC=100										
	CS=10	Th1	0.040 (0.005)	0.030 (0.004)	0.025 (0.003)	0.023 (0.003)	0.034 (0.004)	0.027 (0.004)	0.023 (0.003)	0.021 (0.003)
		Th2	0.044 (0.006)	0.029 (0.004)	0.023 (0.003)	0.022 (0.003)	0.039 (0.005)	0.027 (0.004)	0.022 (0.003)	0.021 (0.003)
	CS=50	Th1	0.017 (0.002)	0.013 (0.002)	0.011 (0.001)	0.010 (0.001)	0.015 (0.002)	0.011 (0.001)	0.010 (0.001)	0.009 (0.001)
		Th2	0.019 (0.002)	0.013 (0.002)	0.010 (0.001)	0.010 (0.001)	0.016 (0.002)	0.011 (0.001)	0.009 (0.001)	0.009 (0.001)
	CS=100	Th1	0.012 (0.002)	0.009 (0.001)	0.008 (0.001)	0.007 (0.001)	0.010 (0.001)	0.008 (0.001)	0.007 (0.001)	0.006 (0.001)
		Th2	0.013 (0.002)	0.009 (0.001)	0.007 (0.001)	0.007 (0.001)	0.012 (0.001)	0.008 (0.001)	0.007 (0.001)	0.006 (0.001)
SRMR-Between										
NC=30										
	CS=10	Th1	0.121 (0.024)	0.111 (0.022)	0.105 (0.021)	0.104 (0.021)	0.296 (0.101)	0.247 (0.088)	0.215 (0.077)	0.209 (0.078)
		Th2	0.131 (0.027)	0.111 (0.022)	0.103 (0.020)	0.103 (0.020)	0.324 (0.107)	0.249 (0.091)	0.216 (0.080)	0.210 (0.079)
	CS=50	Th1	0.088 (0.018)	0.086 (0.018)	0.085 (0.018)	0.085 (0.018)	0.110 (0.023)	0.104 (0.022)	0.100 (0.022)	0.101 (0.021)
		Th2	0.089 (0.019)	0.086 (0.018)	0.085 (0.018)	0.085 (0.018)	0.117 (0.024)	0.105 (0.022)	0.101 (0.021)	0.100 (0.021)

Table B-5 *Continued*

Number of Cluster	Cluster Size	TH	High-ICC 2-cat	High-ICC 3-cat	High-ICC 5-cat	High-ICC 7-cat	Low-ICC 2-cat	Low-ICC 3-cat	Low-ICC 5-cat	Low-ICC 7-cat
	CS=100	Th1	0.085 (0.017)	0.086 (0.017)	0.087 (0.018)	0.087 (0.018)	0.095 (0.020)	0.092 (0.019)	0.091 (0.019)	0.091 (0.019)
		Th2	0.087 (0.017)	0.086 (0.017)	0.087 (0.018)	0.087 (0.019)	0.098 (0.020)	0.092 (0.019)	0.091 (0.019)	0.090 (0.019)
NC=50										
	CS=10	Th1	0.091 (0.016)	0.084 (0.016)	0.079 (0.015)	0.078 (0.015)	0.202 (0.065)	0.166 (0.048)	0.150 (0.046)	0.143 (0.041)
		Th2	0.097 (0.018)	0.084 (0.016)	0.078 (0.015)	0.078 (0.015)	0.233 (0.080)	0.169 (0.053)	0.146 (0.044)	0.142 (0.043)
	CS=50	Th1	0.067 (0.012)	0.065 (0.012)	0.064 (0.012)	0.064 (0.012)	0.083 (0.015)	0.078 (0.014)	0.075 (0.014)	0.075 (0.014)
		Th2	0.068 (0.013)	0.065 (0.012)	0.064 (0.012)	0.064 (0.012)	0.087 (0.016)	0.078 (0.014)	0.075 (0.014)	0.075 (0.014)
	CS=100	Th1	0.065 (0.012)	0.065 (0.013)	0.065 (0.013)	0.065 (0.013)	0.072 (0.013)	0.070 (0.013)	0.068 (0.013)	0.068 (0.013)
		Th2	0.066 (0.013)	0.065 (0.013)	0.065 (0.013)	0.065 (0.013)	0.074 (0.014)	0.070 (0.013)	0.068 (0.013)	0.068 (0.013)
NC=100										
	CS=10	Th1	0.064 (0.010)	0.058 (0.010)	0.055 (0.009)	0.054 (0.009)	0.129 (0.029)	0.107 (0.021)	0.096 (0.019)	0.093 (0.018)
		Th2	0.067 (0.011)	0.058 (0.010)	0.054 (0.009)	0.053 (0.009)	0.145 (0.039)	0.108 (0.022)	0.094 (0.019)	0.092 (0.018)
	CS=50	Th1	0.046 (0.008)	0.045 (0.008)	0.045 (0.008)	0.045 (0.008)	0.057 (0.010)	0.054 (0.009)	0.052 (0.009)	0.052 (0.009)
		Th2	0.048 (0.008)	0.045 (0.008)	0.045 (0.008)	0.045 (0.008)	0.060 (0.010)	0.054 (0.010)	0.052 (0.009)	0.052 (0.009)
	CS=100	Th1	0.044 (0.008)	0.044 (0.008)	0.044 (0.008)	0.044 (0.008)	0.050 (0.009)	0.048 (0.008)	0.047 (0.008)	0.047 (0.008)
		Th2	0.045 (0.008)	0.044 (0.008)	0.044 (0.008)	0.044 (0.008)	0.051 (0.009)	0.048 (0.008)	0.047 (0.008)	0.047 (0.008)

Note. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-6

Chi-square Means and Standard Deviations (in parenthesis) for the MBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	65.05 (13.01)	67.37 (14.14)	70.98 (15.41)	74.17 (16.43)	65.5 (6.77)	66.7 (7.32)	68.59 (7.98)	70.25 (8.51)
		Th2	65.32 (14.40)	66.91 (13.6)	69.93 (15.1)	73.05 (15.65)	65.66 (7.34)	66.47 (7.02)	68.03 (7.8)	69.64 (8.08)
	CS=50	Th1	35.18 (9.53)	26.87 (8.3)	21.22 (6.94)	18.75 (6.25)	54.23 (3.3)	52.5 (2.55)	51.31 (2.01)	50.72 (1.83)
		Th2	35.44 (10.00)	24.87 (7.86)	18.58 (6.32)	17.36 (6.12)	54.27 (3.5)	52.08 (2.28)	50.75 (1.8)	50.42 (1.76)
	CS=100	Th1	15.35 (5.04)	10.34 (3.81)	7.58 (3.02)	6.49 (2.61)	50.82 (1.51)	49.95 (1.33)	49.19 (1.22)	48.64 (1.19)
		Th2	15.63 (5.29)	9.5 (3.53)	6.47 (2.54)	5.9 (2.39)	50.92 (1.62)	49.81 (1.26)	48.87 (1.2)	48.5 (1.14)
NC=50										
	CS=10	Th1	69.13 (14.12)	71.21 (14.79)	74.36 (16.05)	76.92 (16.41)	67.89 (8.57)	69.15 (8.94)	71.03 (9.68)	72.59 (9.91)
		Th2	68.55 (14.29)	71.08 (14.96)	74.14 (15.87)	76.88 (16.33)	67.52 (8.55)	69.04 (8.98)	70.89 (9.54)	72.54 (9.82)
	CS=50	Th1	46.48 (11.13)	37.63 (9.75)	31.15 (8.75)	28.59 (8.23)	57.12 (4.97)	54.63 (3.72)	53.08 (3.06)	52.51 (2.78)
		Th2	46 (11.47)	35.18 (9.11)	27.69 (7.7)	26.56 (7.52)	56.88 (5.17)	53.92 (3.42)	52.15 (2.61)	51.97 (2.53)
	CS=100	Th1	23.11 (6.85)	16.1 (5.18)	12.28 (4.06)	10.84 (3.68)	51.87 (2.08)	50.56 (1.64)	49.74 (1.38)	49.29 (1.32)
		Th2	23.11 (6.63)	14.94 (4.71)	10.7 (3.57)	9.99 (3.41)	51.83 (2.07)	50.33 (1.5)	49.34 (1.31)	49.09 (1.3)
NC=100										
	CS=10	Th1	75.72 (14.75)	78.04 (16.37)	80.99 (16.96)	83.08 (17.64)	72.9 (10.48)	74.5 (11.56)	76.55 (11.93)	78.01 (12.38)
		Th2	74.54 (14.55)	78.14 (15.62)	81.4 (17.36)	83.19 (17.86)	72 (10.22)	74.53 (10.97)	76.8 (12.14)	78.06 (12.5)
	CS=50	Th1	64.61 (13.74)	56.68 (12.61)	49.74 (11.55)	46.91 (11.07)	65.29 (8.1)	61.37 (6.43)	58.63 (5.25)	57.67 (4.81)
		Th2	63.53 (13.35)	53.88 (12.12)	45.75 (10.78)	44.56 (10.54)	64.65 (7.89)	60.13 (5.96)	57.18 (4.66)	56.88 (4.42)
	CS=100	Th1	38.72 (9.4)	29.72 (7.78)	24.09 (6.4)	21.64 (5.78)	55.5 (3.46)	53.34 (2.59)	52.09 (2.04)	51.49 (1.81)
		Th2	39.04 (9.02)	27.65 (7.19)	21.03 (5.73)	20.08 (5.55)	55.5 (3.38)	52.87 (2.34)	51.34 (1.8)	51.13 (1.79)
Low-ICC										
NC=30										
	CS=10	Th1	58.57 (13.91)	63.66 (14.02)	69.02 (15.42)	73.98 (16.98)	62.5 (6.78)	64.95 (7.07)	67.65 (7.87)	70.22 (8.73)
		Th2	55.01 (14.42)	63.78 (14.82)	69.86 (15.79)	74.28 (16.78)	60.99 (6.75)	65.05 (7.38)	68.11 (8.02)	70.42 (8.6)
	CS=50	Th1	61.61 (13.37)	60.36 (13.37)	59.51 (14.35)	60.64 (14.24)	63.8 (6.77)	63.33 (6.44)	63.15 (6.63)	63.73 (6.5)
		Th2	61.4 (13.18)	59.64 (13.39)	58.65 (13.88)	59.63 (14.26)	63.69 (6.68)	63.01 (6.46)	62.79 (6.33)	63.31 (6.41)

Table B-6 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	48.56 (11.55)	42.17 (10.82)	37.87 (9.96)	35.82 (10)	58.81 (4.73)	57.12 (3.84)	56.15 (3.22)	55.67 (3.1)
		Th2	50.28 (11.97)	41.44 (10.69)	35.97 (9.72)	34.72 (10.5)	59.42 (5.02)	56.97 (3.7)	55.72 (2.99)	55.39 (3.32)
NC=50										
	CS=10	Th1	64.63 (13.66)	68.4 (14.03)	71.72 (14.91)	75.84 (15.51)	65.23 (8.21)	67.45 (8.48)	69.48 (9)	71.98 (9.37)
		Th2	62.35 (13.49)	68.64 (14.41)	72.38 (15.33)	75.59 (16.07)	64 (7.9)	67.61 (8.67)	69.87 (9.25)	71.82 (9.71)
	CS=50	Th1	67.04 (14.31)	66.67 (14.59)	66.55 (14.65)	67.98 (15.12)	66.63 (8.58)	66.44 (8.48)	66.43 (8.26)	67.22 (8.31)
		Th2	66.54 (14.11)	65.92 (14.68)	65.31 (14.3)	66.77 (14.77)	66.35 (8.45)	66 (8.47)	65.74 (7.88)	66.57 (8.03)
	CS=100	Th1	57.08 (12.48)	51.22 (11.92)	47.65 (11.47)	46.24 (11.36)	61.68 (6.25)	59.59 (5.19)	58.62 (4.54)	58.31 (4.28)
		Th2	58.37 (12.58)	50.55 (11.47)	45.77 (11.07)	45.3 (11.1)	62.24 (6.43)	59.31 (4.96)	58.03 (4.26)	58.04 (4.17)
NC=100										
	CS=10	Th1	69.26 (13.46)	71.89 (15.38)	74.18 (15.74)	76.23 (16.22)	68.32 (9.68)	70.18 (10.95)	71.77 (11.12)	73.23 (11.45)
		Th2	68.54 (13.58)	71.67 (15.44)	74.29 (15.78)	76.35 (16.46)	67.81 (9.69)	70 (10.94)	71.83 (11.12)	73.29 (11.59)
	CS=50	Th1	75.68 (14.94)	76.9 (16.19)	77.3 (16.2)	78.19 (16.75)	72.83 (10.52)	73.58 (11.21)	73.69 (10.98)	74.24 (11.25)
		Th2	74.94 (15.77)	76.62 (15.86)	76.77 (16.48)	77.86 (16.7)	72.3 (11.11)	73.34 (10.94)	73.27 (11.06)	73.94 (11.13)
	CS=100	Th1	70.22 (14.54)	66.64 (14.55)	63.69 (14.19)	62.66 (13.89)	68.8 (9.28)	66.54 (8.39)	65.05 (7.47)	64.58 (6.96)
		Th2	70.59 (14.36)	65.53 (14.2)	61.75 (13.99)	61.78 (13.84)	69.04 (9.27)	65.93 (8.06)	64.12 (7.14)	64.15 (6.8)

Note. MBc = Complex misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-7

CFI Means and Standard Deviations (in parenthesis) for the MBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.989 (0.018)	0.991 (0.014)	0.991 (0.012)	0.991 (0.011)	0.986 (0.023)	0.988 (0.018)	0.989 (0.015)	0.988 (0.014)
		Th2	0.986 (0.023)	0.992 (0.013)	0.993 (0.01)	0.992 (0.01)	0.983 (0.029)	0.99 (0.016)	0.991 (0.013)	0.99 (0.013)
	CS=50	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
	CS=100	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
NC=50										
	CS=10	Th1	0.99 (0.014)	0.992 (0.01)	0.993 (0.008)	0.993 (0.007)	0.987 (0.019)	0.989 (0.014)	0.99 (0.011)	0.99 (0.01)
		Th2	0.989 (0.016)	0.993 (0.01)	0.994 (0.007)	0.994 (0.007)	0.986 (0.021)	0.99 (0.013)	0.992 (0.01)	0.991 (0.01)
	CS=50	Th1	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
		Th2	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
	CS=100	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
NC=100										
	CS=10	Th1	0.992 (0.008)	0.994 (0.006)	0.995 (0.005)	0.995 (0.005)	0.989 (0.012)	0.991 (0.009)	0.992 (0.007)	0.992 (0.007)
		Th2	0.992 (0.009)	0.994 (0.006)	0.995 (0.005)	0.995 (0.004)	0.988 (0.013)	0.991 (0.009)	0.993 (0.007)	0.992 (0.007)
	CS=50	Th1	0.999 (0.002)	1 (0.001)	1 (0)	1 (0)	0.999 (0.002)	1 (0.001)	1 (0)	1 (0)
		Th2	0.999 (0.002)	1 (0.001)	1 (0)	1 (0)	0.999 (0.002)	1 (0.001)	1 (0)	1 (0)
	CS=100	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
Low-ICC										
NC=30										
	CS=10	Th1	0.994 (0.013)	0.994 (0.011)	0.993 (0.01)	0.992 (0.01)	0.993 (0.016)	0.993 (0.014)	0.991 (0.013)	0.99 (0.013)
		Th2	0.995 (0.015)	0.994 (0.011)	0.993 (0.009)	0.992 (0.009)	0.994 (0.018)	0.992 (0.014)	0.991 (0.012)	0.99 (0.012)
	CS=50	Th1	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.998 (0.004)	0.999 (0.002)	0.999 (0.002)	0.999 (0.002)
		Th2	0.998 (0.004)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.998 (0.005)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)

Table B-7 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
		Th2	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
NC=50										
	CS=10	Th1	0.994 (0.011)	0.995 (0.008)	0.995 (0.007)	0.994 (0.006)	0.992 (0.014)	0.993 (0.011)	0.993 (0.009)	0.992 (0.009)
		Th2	0.994 (0.011)	0.994 (0.008)	0.995 (0.006)	0.994 (0.006)	0.993 (0.013)	0.993 (0.011)	0.993 (0.009)	0.992 (0.009)
	CS=50	Th1	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.998 (0.003)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)
		Th2	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.998 (0.004)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)
	CS=100	Th1	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
		Th2	1 (0.001)	1 (0)	1 (0)	1 (0)	0.999 (0.001)	1 (0)	1 (0)	1 (0)
NC=100										
	CS=10	Th1	0.995 (0.006)	0.996 (0.005)	0.997 (0.004)	0.997 (0.004)	0.994 (0.008)	0.995 (0.007)	0.995 (0.006)	0.995 (0.006)
		Th2	0.995 (0.007)	0.996 (0.005)	0.997 (0.004)	0.997 (0.004)	0.993 (0.01)	0.995 (0.007)	0.995 (0.005)	0.995 (0.005)
	CS=50	Th1	0.998 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.998 (0.002)	0.998 (0.002)	0.999 (0.001)	0.999 (0.001)
		Th2	0.998 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.997 (0.003)	0.998 (0.002)	0.999 (0.001)	0.999 (0.001)
	CS=100	Th1	0.999 (0.001)	1 (0)	1 (0)	1 (0)	0.999 (0.001)	1 (0.001)	1 (0)	1 (0)
		Th2	0.999 (0.001)	1 (0)	1 (0)	1 (0)	0.999 (0.001)	1 (0.001)	1 (0)	1 (0)

Note. MBc = Complex misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-8

TLI Means and Standard Deviations (in parenthesis) for the MBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	1.004 (0.042)	0.998 (0.029)	0.994 (0.021)	0.991 (0.019)	1.005 (0.054)	0.997 (0.038)	0.992 (0.028)	0.988 (0.025)
		Th2	1.004 (0.054)	0.999 (0.027)	0.995 (0.019)	0.993 (0.017)	1.005 (0.067)	0.998 (0.035)	0.994 (0.025)	0.991 (0.022)
	CS=50	Th1	1.036 (0.015)	1.034 (0.011)	1.032 (0.01)	1.031 (0.01)	1.038 (0.015)	1.034 (0.011)	1.031 (0.01)	1.031 (0.01)
		Th2	1.041 (0.018)	1.036 (0.012)	1.032 (0.01)	1.031 (0.01)	1.043 (0.018)	1.035 (0.011)	1.031 (0.009)	1.031 (0.01)
	CS=100	Th1	1.061 (0.018)	1.054 (0.017)	1.051 (0.017)	1.051 (0.017)	1.06 (0.018)	1.054 (0.018)	1.052 (0.018)	1.052 (0.018)
		Th2	1.068 (0.019)	1.056 (0.019)	1.05 (0.019)	1.051 (0.019)	1.067 (0.019)	1.057 (0.019)	1.052 (0.02)	1.053 (0.02)
NC=50										
	CS=10	Th1	0.994 (0.027)	0.994 (0.018)	0.993 (0.014)	0.992 (0.012)	0.992 (0.036)	0.992 (0.025)	0.99 (0.02)	0.989 (0.017)
		Th2	0.995 (0.031)	0.994 (0.018)	0.994 (0.012)	0.993 (0.011)	0.994 (0.04)	0.992 (0.024)	0.991 (0.017)	0.99 (0.016)
	CS=50	Th1	1.012 (0.007)	1.012 (0.005)	1.012 (0.004)	1.011 (0.004)	1.013 (0.008)	1.012 (0.005)	1.012 (0.004)	1.011 (0.003)
		Th2	1.013 (0.008)	1.013 (0.005)	1.012 (0.003)	1.012 (0.003)	1.015 (0.009)	1.013 (0.005)	1.012 (0.003)	1.011 (0.003)
	CS=100	Th1	1.023 (0.006)	1.021 (0.005)	1.019 (0.005)	1.019 (0.005)	1.022 (0.006)	1.02 (0.005)	1.019 (0.005)	1.019 (0.005)
		Th2	1.026 (0.007)	1.022 (0.006)	1.019 (0.005)	1.018 (0.005)	1.025 (0.007)	1.021 (0.006)	1.019 (0.005)	1.018 (0.005)
NC=100										
	CS=10	Th1	0.991 (0.014)	0.993 (0.01)	0.993 (0.008)	0.993 (0.007)	0.987 (0.02)	0.989 (0.015)	0.99 (0.012)	0.99 (0.01)
		Th2	0.991 (0.015)	0.993 (0.009)	0.994 (0.007)	0.994 (0.006)	0.987 (0.022)	0.989 (0.014)	0.991 (0.011)	0.99 (0.01)
	CS=50	Th1	1 (0.003)	1.002 (0.002)	1.002 (0.002)	1.002 (0.001)	1 (0.004)	1.002 (0.003)	1.002 (0.002)	1.002 (0.001)
		Th2	1.001 (0.004)	1.002 (0.002)	1.002 (0.001)	1.002 (0.001)	1.001 (0.005)	1.002 (0.002)	1.003 (0.001)	1.003 (0.001)
	CS=100	Th1	1.005 (0.002)	1.005 (0.001)	1.005 (0.001)	1.005 (0.001)	1.005 (0.002)	1.005 (0.001)	1.005 (0.001)	1.005 (0.001)
		Th2	1.006 (0.002)	1.006 (0.001)	1.005 (0.001)	1.005 (0.001)	1.006 (0.002)	1.005 (0.001)	1.005 (0.001)	1.005 (0.001)
Low-ICC										
NC=30										
	CS=10	Th1	1.024 (0.044)	1.005 (0.026)	0.997 (0.02)	0.992 (0.017)	1.027 (0.051)	1.005 (0.032)	0.995 (0.025)	0.99 (0.022)
		Th2	1.044 (0.059)	1.005 (0.027)	0.996 (0.018)	0.992 (0.017)	1.048 (0.066)	1.005 (0.033)	0.994 (0.023)	0.99 (0.021)
	CS=50	Th1	1.003 (0.009)	1.002 (0.006)	1.002 (0.004)	1.001 (0.004)	1.004 (0.011)	1.003 (0.007)	1.002 (0.005)	1.002 (0.004)
		Th2	1.004 (0.01)	1.003 (0.006)	1.002 (0.004)	1.002 (0.004)	1.005 (0.013)	1.003 (0.007)	1.003 (0.005)	1.002 (0.004)

Table B-8 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	1.007 (0.005)	1.007 (0.004)	1.006 (0.003)	1.006 (0.003)	1.008 (0.005)	1.007 (0.004)	1.006 (0.003)	1.006 (0.003)
		Th2	1.008 (0.006)	1.007 (0.004)	1.007 (0.003)	1.006 (0.003)	1.009 (0.007)	1.007 (0.004)	1.006 (0.003)	1.006 (0.003)
NC=50										
	CS=10	Th1	1.003 (0.025)	0.997 (0.016)	0.995 (0.012)	0.993 (0.011)	1.003 (0.031)	0.997 (0.021)	0.994 (0.016)	0.991 (0.014)
		Th2	1.009 (0.03)	0.997 (0.016)	0.995 (0.011)	0.994 (0.011)	1.01 (0.036)	0.996 (0.021)	0.994 (0.015)	0.991 (0.014)
	CS=50	Th1	1 (0.005)	1 (0.003)	1 (0.003)	1 (0.002)	1 (0.007)	1 (0.005)	1 (0.003)	1 (0.003)
		Th2	1 (0.006)	1 (0.004)	1 (0.002)	1 (0.002)	1 (0.008)	1 (0.005)	1 (0.003)	1 (0.003)
	CS=100	Th1	1.002 (0.003)	1.002 (0.002)	1.002 (0.001)	1.002 (0.001)	1.002 (0.003)	1.003 (0.002)	1.002 (0.002)	1.002 (0.001)
		Th2	1.002 (0.003)	1.002 (0.002)	1.002 (0.001)	1.002 (0.001)	1.003 (0.004)	1.003 (0.002)	1.002 (0.001)	1.002 (0.001)
NC=100										
	CS=10	Th1	0.997 (0.012)	0.997 (0.009)	0.997 (0.007)	0.996 (0.006)	0.996 (0.016)	0.995 (0.012)	0.995 (0.01)	0.994 (0.009)
		Th2	0.997 (0.014)	0.997 (0.009)	0.997 (0.006)	0.996 (0.006)	0.997 (0.019)	0.996 (0.012)	0.995 (0.009)	0.995 (0.009)
	CS=50	Th1	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.997 (0.004)	0.998 (0.003)	0.999 (0.002)	0.999 (0.002)
		Th2	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.997 (0.005)	0.998 (0.003)	0.999 (0.002)	0.999 (0.002)
	CS=100	Th1	1 (0.001)	1 (0.001)	1 (0.001)	1 (0.001)	0.999 (0.002)	1 (0.001)	1 (0.001)	1 (0.001)
		Th2	0.999 (0.002)	1 (0.001)	1 (0.001)	1 (0.001)	0.999 (0.002)	1 (0.001)	1 (0.001)	1 (0.001)

Note. MBc = Complex misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-9

RMSEA Means and Standard Deviations (in parenthesis) for the MBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.009 (0.012)	0.012 (0.014)	0.015 (0.015)	0.018 (0.016)	0.007 (0.009)	0.008 (0.01)	0.011 (0.011)	0.013 (0.011)
		Th2	0.01 (0.013)	0.011 (0.013)	0.014 (0.014)	0.017 (0.015)	0.007 (0.009)	0.008 (0.009)	0.01 (0.01)	0.012 (0.011)
	CS=50	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.01 (0.011)	0.011 (0.011)	0.014 (0.012)	0.016 (0.012)	0.008 (0.008)	0.009 (0.009)	0.011 (0.009)	0.012 (0.009)
		Th2	0.009 (0.011)	0.011 (0.011)	0.014 (0.012)	0.016 (0.012)	0.007 (0.008)	0.009 (0.009)	0.011 (0.009)	0.012 (0.009)
	CS=50	Th1	0 (0.001)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.002)	0 (0)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=100										
	CS=10	Th1	0.011 (0.008)	0.012 (0.009)	0.013 (0.009)	0.014 (0.009)	0.009 (0.007)	0.01 (0.007)	0.011 (0.007)	0.012 (0.007)
		Th2	0.01 (0.008)	0.012 (0.008)	0.013 (0.009)	0.014 (0.009)	0.008 (0.007)	0.01 (0.007)	0.011 (0.007)	0.012 (0.007)
	CS=50	Th1	0.002 (0.003)	0.001 (0.002)	0 (0.001)	0 (0.001)	0.002 (0.002)	0.001 (0.002)	0 (0.001)	0 (0.001)
		Th2	0.002 (0.003)	0.001 (0.002)	0 (0.001)	0 (0.001)	0.002 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Low-ICC										
NC=30										
	CS=10	Th1	0.005 (0.01)	0.009 (0.012)	0.013 (0.014)	0.017 (0.016)	0.004 (0.007)	0.006 (0.009)	0.01 (0.01)	0.013 (0.011)
		Th2	0.004 (0.009)	0.009 (0.013)	0.014 (0.015)	0.018 (0.016)	0.003 (0.007)	0.007 (0.009)	0.01 (0.011)	0.013 (0.011)
	CS=50	Th1	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)	0.002 (0.004)	0.002 (0.003)	0.002 (0.003)	0.002 (0.004)
		Th2	0.003 (0.005)	0.003 (0.005)	0.002 (0.005)	0.003 (0.005)	0.002 (0.004)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)

Table B-9 *Continued*

Number of Cluster	Cluster Size	TH	WLSM				WLSMV			
			2-cat	3-cat	5-cat	7-cat	2-cat	3-cat	5-cat	7-cat
	CS=100	Th1	0 (0.002)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0.001)	0 (0)	0 (0)
		Th2	0.001 (0.002)	0 (0.001)	0 (0)	0 (0)	0 (0.001)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.007 (0.01)	0.009 (0.011)	0.012 (0.011)	0.015 (0.012)	0.005 (0.008)	0.007 (0.008)	0.009 (0.009)	0.012 (0.009)
		Th2	0.006 (0.009)	0.01 (0.011)	0.012 (0.012)	0.015 (0.012)	0.005 (0.007)	0.008 (0.008)	0.01 (0.009)	0.012 (0.009)
	CS=50	Th1	0.004 (0.005)	0.004 (0.005)	0.004 (0.005)	0.004 (0.005)	0.003 (0.004)	0.003 (0.004)	0.003 (0.004)	0.003 (0.004)
		Th2	0.004 (0.005)	0.004 (0.005)	0.003 (0.004)	0.004 (0.005)	0.003 (0.004)	0.003 (0.004)	0.003 (0.003)	0.003 (0.004)
	CS=100	Th1	0.001 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)	0.001 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)
		Th2	0.001 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)	0.001 (0.002)	0 (0.001)	0 (0.001)	0 (0.001)
NC=100										
	CS=10	Th1	0.007 (0.007)	0.009 (0.008)	0.01 (0.008)	0.011 (0.009)	0.006 (0.006)	0.007 (0.007)	0.008 (0.007)	0.009 (0.007)
		Th2	0.007 (0.007)	0.008 (0.008)	0.01 (0.008)	0.011 (0.009)	0.006 (0.006)	0.007 (0.007)	0.008 (0.007)	0.009 (0.007)
	CS=50	Th1	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)
		Th2	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)
	CS=100	Th1	0.002 (0.003)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
		Th2	0.003 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.001)	0.001 (0.001)

Note. MBc = Complex misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-10

SRMR-Between Means and Standard Deviations (in parenthesis) for the MBc by ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
NC=30										
	CS=10	Th1	0.135 (0.027)	0.126 (0.026)	0.120 (0.025)	0.119 (0.025)	0.309 (0.100)	0.260 (0.089)	0.229 (0.084)	0.222 (0.078)
		Th2	0.145 (0.031)	0.125 (0.026)	0.118 (0.025)	0.118 (0.025)	0.339 (0.109)	0.264 (0.092)	0.231 (0.082)	0.224 (0.080)
	CS=50	Th1	0.102 (0.022)	0.100 (0.022)	0.100 (0.022)	0.100 (0.022)	0.125 (0.028)	0.119 (0.026)	0.115 (0.025)	0.116 (0.026)
		Th2	0.104 (0.023)	0.101 (0.022)	0.100 (0.022)	0.100 (0.022)	0.130 (0.028)	0.119 (0.026)	0.116 (0.026)	0.116 (0.026)
	CS=100	Th1	0.100 (0.022)	0.101 (0.022)	0.102 (0.023)	0.103 (0.023)	0.109 (0.024)	0.107 (0.023)	0.106 (0.024)	0.107 (0.024)
		Th2	0.102 (0.022)	0.102 (0.022)	0.103 (0.023)	0.103 (0.023)	0.112 (0.024)	0.107 (0.024)	0.106 (0.023)	0.106 (0.024)
NC=50										
	CS=10	Th1	0.107 (0.021)	0.100 (0.020)	0.096 (0.019)	0.095 (0.019)	0.217 (0.069)	0.180 (0.051)	0.164 (0.047)	0.158 (0.043)
		Th2	0.112 (0.022)	0.099 (0.020)	0.094 (0.019)	0.094 (0.019)	0.247 (0.083)	0.183 (0.054)	0.161 (0.047)	0.156 (0.045)
	CS=50	Th1	0.084 (0.017)	0.082 (0.017)	0.082 (0.017)	0.082 (0.017)	0.098 (0.019)	0.094 (0.019)	0.092 (0.019)	0.092 (0.019)
		Th2	0.085 (0.018)	0.082 (0.017)	0.082 (0.017)	0.082 (0.017)	0.102 (0.020)	0.094 (0.019)	0.092 (0.018)	0.092 (0.019)
	CS=100	Th1	0.082 (0.016)	0.082 (0.017)	0.082 (0.017)	0.083 (0.017)	0.089 (0.018)	0.087 (0.017)	0.086 (0.017)	0.086 (0.017)
		Th2	0.083 (0.016)	0.082 (0.017)	0.083 (0.017)	0.083 (0.017)	0.090 (0.018)	0.087 (0.017)	0.086 (0.017)	0.086 (0.017)
NC=100										
	CS=10	Th1	0.081 (0.014)	0.077 (0.014)	0.074 (0.013)	0.074 (0.013)	0.143 (0.031)	0.121 (0.024)	0.112 (0.023)	0.109 (0.022)
		Th2	0.084 (0.014)	0.077 (0.014)	0.073 (0.013)	0.073 (0.013)	0.159 (0.041)	0.122 (0.025)	0.109 (0.022)	0.107 (0.022)
	CS=50	Th1	0.067 (0.013)	0.067 (0.013)	0.066 (0.012)	0.066 (0.013)	0.075 (0.014)	0.074 (0.014)	0.072 (0.013)	0.072 (0.013)
		Th2	0.068 (0.013)	0.067 (0.013)	0.066 (0.012)	0.066 (0.012)	0.079 (0.014)	0.074 (0.014)	0.072 (0.013)	0.072 (0.013)
	CS=100	Th1	0.066 (0.011)	0.066 (0.012)	0.066 (0.012)	0.066 (0.012)	0.070 (0.012)	0.068 (0.012)	0.068 (0.012)	0.068 (0.013)
		Th2	0.066 (0.012)	0.066 (0.012)	0.066 (0.012)	0.066 (0.012)	0.071 (0.012)	0.069 (0.012)	0.068 (0.012)	0.068 (0.013)

Note. MBc = Complex misspecified between-level model. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-11

Chi-Square Means and Standard Deviations (in parenthesis) for the MWc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	70.6 (14.74)	78.36 (17.67)	89.75 (21.12)	97.98 (23.96)	68.39 (7.67)	72.42 (9.17)	78.35 (10.97)	82.64 (12.47)
		Th2	70.14 (16.45)	78.83 (17.71)	91.71 (22.95)	99.03 (24.56)	68.11 (8.4)	72.63 (9.15)	79.31 (11.85)	83.11 (12.71)
	CS=50	Th1	52.25 (14.49)	50.44 (14.98)	48.88 (15.37)	47.51 (15.52)	60.91 (5.55)	60.8 (5.18)	60.56 (5.03)	60.18 (5)
		Th2	50.33 (13.93)	47.65 (14.15)	47.2 (14.97)	46.56 (15.19)	60.11 (5.29)	59.96 (4.69)	60.11 (4.78)	59.93 (4.83)
	CS=100	Th1	28.21 (9.15)	25.82 (9.03)	24.07 (8.64)	22.84 (8.18)	54.74 (2.52)	54.47 (2.42)	53.98 (2.34)	53.44 (2.3)
		Th2	26.88 (8.89)	24.5 (8.57)	23.49 (8.01)	22.46 (8.25)	54.32 (2.46)	54.14 (2.3)	53.81 (2.19)	53.36 (2.31)
NC=50										
	CS=10	Th1	77.2 (17.05)	87.73 (19.84)	102.46 (24.11)	112.11 (26.97)	72.8 (10.34)	79.16 (11.97)	88.04 (14.52)	93.9 (16.26)
		Th2	75.18 (16.53)	88.99 (20.72)	107.71 (26.6)	115.83 (28.59)	71.49 (9.89)	79.83 (12.43)	91.13 (15.94)	96.06 (17.17)
	CS=50	Th1	81.97 (18.69)	89.14 (21.59)	94.43 (23.09)	97.01 (24.09)	73.69 (9.02)	75.77 (9.36)	76.99 (9.22)	77.59 (9.31)
		Th2	76.47 (18.37)	86.38 (20.28)	95.16 (23.37)	97.04 (24.26)	71.22 (8.91)	74.4 (8.53)	76.95 (9.1)	77.44 (9.25)
	CS=100	Th1	55.6 (14.65)	56.19 (15.43)	56.95 (15.78)	56.71 (15.96)	62.75 (4.82)	63.12 (4.78)	63.4 (4.76)	63.29 (4.84)
		Th2	51.03 (14.22)	54.04 (14.93)	57.23 (16)	56.75 (16.15)	61.21 (4.63)	62.47 (4.56)	63.48 (4.83)	63.32 (4.89)
NC=100										
	CS=10	Th1	91.56 (19.82)	111.11 (23.53)	134.45 (29.14)	147.94 (32.64)	84.13 (14.03)	97.86 (16.56)	114.16 (20.42)	123.56 (22.83)
		Th2	87.34 (18.79)	112.93 (25.48)	144.67 (32.08)	155.17 (34.03)	80.99 (13.17)	98.94 (17.84)	121.14 (22.35)	128.51 (23.72)
	CS=50	Th1	155.68 (29.4)	196.53 (35.9)	229.89 (39.72)	246.61 (44.14)	118.96 (18.29)	133.3 (20.86)	142.33 (21.41)	146.72 (22.89)
		Th2	140.89 (27.21)	195.96 (35.58)	241.27 (41.13)	252.3 (43.69)	110.35 (16.88)	130.96 (19.83)	144.07 (21.16)	147.02 (22.22)
	CS=100	Th1	142.48 (28.37)	166.17 (33.02)	183.47 (36.86)	190.48 (40.15)	96.23 (12.4)	101.66 (13.23)	105.55 (13.69)	107.29 (14.6)
		Th2	129.05 (26.46)	161.24 (33.68)	186.92 (38.5)	190.37 (39.71)	91.22 (11.55)	99.25 (13.12)	105.99 (14.11)	106.8 (14.31)
Low-ICC										
NC=30										
	CS=10	Th1	65.7 (16.65)	77.87 (18.58)	90.82 (22.62)	100.8 (25.75)	66.11 (8.28)	72.23 (9.55)	78.89 (11.73)	84.12 (13.43)
		Th2	61.88 (16.22)	77.35 (19.58)	93.19 (23.75)	102.22 (26.37)	64.31 (7.83)	71.96 (9.96)	80.13 (12.3)	84.87 (13.78)
	CS=50	Th1	101.51 (23.66)	123.68 (29.56)	147.07 (35.74)	160.22 (40.25)	84.2 (12.19)	94.41 (15.05)	104.24 (17.91)	109.59 (20.09)
		Th2	93.56 (21.78)	122.88 (29.32)	150.04 (37.07)	161.27 (41.69)	80.14 (11.21)	93.83 (14.83)	105.1 (18.56)	109.64 (20.89)

Table B-11 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	101.93 (24.78)	114.75 (30.2)	125.21 (35.69)	127.28 (38.42)	81.68 (11.35)	85.25 (13.12)	87.88 (14.65)	88.12 (15.23)
		Th2	96.53 (23.94)	112.79 (29.92)	125.32 (36.54)	128.87 (41.19)	79.63 (11.1)	84.3 (12.79)	87.53 (14.94)	88.43 (15.88)
NC=50										
	CS=10	Th1	77.11 (16.74)	91.04 (19.75)	105.34 (23.75)	116.64 (26.63)	72.84 (10.14)	81.25 (12.02)	89.9 (14.4)	96.79 (16.14)
		Th2	72.65 (16.25)	91.43 (20.97)	110.49 (26.19)	119.45 (28.28)	70.12 (9.65)	81.43 (12.69)	92.99 (15.87)	98.47 (17.17)
	CS=50	Th1	137.01 (28.84)	181.97 (37.8)	225.71 (47.06)	251.18 (50.17)	108.64 (17.4)	133.46 (22.7)	155.39 (28.05)	167.36 (29.62)
		Th2	124.15 (26.48)	180.46 (35.75)	235.9 (47.74)	257.82 (52.46)	100.91 (15.93)	131.96 (21.1)	159.43 (28.31)	169.94 (31.02)
	CS=100	Th1	166.1 (34.58)	205.5 (44.62)	241.15 (52.5)	254 (58.22)	117.13 (19.87)	129.49 (24.49)	139.73 (27.52)	142.37 (29.13)
		Th2	149.16 (30.46)	202.17 (42.68)	246.08 (56.01)	257.51 (59.43)	109.01 (17.46)	127.26 (23.14)	139.84 (28.35)	142.69 (29.38)
NC=100										
	CS=10	Th1	94.45 (20)	116.17 (25.03)	139.44 (30.22)	153.05 (32.99)	86.49 (14.37)	101.81 (17.81)	118.11 (21.36)	127.67 (23.24)
		Th2	88.29 (17.8)	116.49 (25.4)	146.84 (31.81)	158.14 (34)	81.93 (12.69)	101.89 (17.98)	123.19 (22.41)	131.16 (23.91)
	CS=50	Th1	228.19 (39.36)	328.38 (52.8)	425.02 (67.1)	477.35 (73.48)	180.38 (27.75)	247.48 (36.97)	308.23 (47.13)	340.03 (52.17)
		Th2	197.69 (36.65)	327.76 (53.27)	452.87 (70.14)	495.04 (76.38)	158.92 (25.85)	245.88 (37.19)	323.64 (49.18)	348.99 (54.11)
	CS=100	Th1	333.89 (52.82)	461 (72.37)	568.25 (89.6)	618.88 (104.5)	233.92 (38.53)	289.32 (51.73)	326.73 (63.75)	340.56 (69.89)
		Th2	289.36 (47.96)	454.7 (73.35)	590.99 (95.32)	631.73 (104.8)	207.95 (33.66)	282.23 (52.51)	329.98 (65.76)	341.22 (68.71)

Note. MWc = Complex misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-12

CFI Means and Standard Deviations (in parenthesis) for the MWc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.981 (0.025)	0.979 (0.022)	0.976 (0.02)	0.973 (0.02)	0.976 (0.031)	0.973 (0.029)	0.968 (0.027)	0.965 (0.026)
		Th2	0.978 (0.032)	0.979 (0.022)	0.977 (0.02)	0.974 (0.019)	0.972 (0.041)	0.973 (0.029)	0.969 (0.026)	0.966 (0.025)
	CS=50	Th1	0.999 (0.004)	0.999 (0.003)	0.999 (0.002)	0.999 (0.002)	0.999 (0.004)	0.999 (0.003)	0.999 (0.002)	0.999 (0.002)
		Th2	0.999 (0.004)	1 (0.002)	1 (0.002)	1 (0.002)	0.999 (0.004)	1 (0.002)	1 (0.002)	1 (0.002)
	CS=100	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
NC=50										
	CS=10	Th1	0.982 (0.02)	0.98 (0.017)	0.977 (0.015)	0.975 (0.014)	0.976 (0.026)	0.973 (0.023)	0.967 (0.021)	0.965 (0.021)
		Th2	0.982 (0.021)	0.98 (0.017)	0.977 (0.015)	0.975 (0.014)	0.976 (0.028)	0.972 (0.023)	0.967 (0.021)	0.965 (0.02)
	CS=50	Th1	0.993 (0.007)	0.993 (0.006)	0.993 (0.005)	0.993 (0.005)	0.992 (0.008)	0.993 (0.006)	0.993 (0.005)	0.993 (0.005)
		Th2	0.994 (0.007)	0.994 (0.005)	0.994 (0.004)	0.994 (0.004)	0.993 (0.008)	0.994 (0.005)	0.994 (0.005)	0.994 (0.004)
	CS=100	Th1	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)
		Th2	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.001)
NC=100										
	CS=10	Th1	0.982 (0.013)	0.98 (0.01)	0.978 (0.01)	0.977 (0.009)	0.975 (0.019)	0.97 (0.016)	0.965 (0.015)	0.964 (0.015)
		Th2	0.983 (0.013)	0.98 (0.011)	0.977 (0.009)	0.976 (0.009)	0.976 (0.019)	0.97 (0.017)	0.965 (0.015)	0.963 (0.015)
	CS=50	Th1	0.984 (0.005)	0.984 (0.004)	0.984 (0.004)	0.984 (0.003)	0.979 (0.007)	0.981 (0.005)	0.982 (0.004)	0.983 (0.004)
		Th2	0.985 (0.005)	0.984 (0.004)	0.984 (0.003)	0.984 (0.003)	0.98 (0.008)	0.982 (0.005)	0.983 (0.004)	0.984 (0.004)
	CS=100	Th1	0.989 (0.003)	0.99 (0.003)	0.99 (0.002)	0.99 (0.002)	0.989 (0.004)	0.99 (0.003)	0.99 (0.002)	0.991 (0.002)
		Th2	0.99 (0.004)	0.99 (0.003)	0.991 (0.002)	0.991 (0.002)	0.99 (0.004)	0.99 (0.003)	0.991 (0.002)	0.991 (0.002)
Low-ICC										
NC=30										
	CS=10	Th1	0.987 (0.021)	0.981 (0.021)	0.977 (0.02)	0.974 (0.019)	0.984 (0.027)	0.976 (0.026)	0.97 (0.026)	0.966 (0.025)
		Th2	0.988 (0.023)	0.982 (0.021)	0.977 (0.019)	0.974 (0.019)	0.986 (0.028)	0.977 (0.026)	0.97 (0.025)	0.967 (0.024)
	CS=50	Th1	0.984 (0.01)	0.983 (0.008)	0.983 (0.007)	0.983 (0.007)	0.979 (0.013)	0.979 (0.011)	0.98 (0.009)	0.98 (0.008)
		Th2	0.985 (0.011)	0.983 (0.008)	0.983 (0.007)	0.983 (0.007)	0.981 (0.014)	0.98 (0.01)	0.98 (0.008)	0.981 (0.008)

Table B-12 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.99 (0.006)	0.99 (0.005)	0.991 (0.005)	0.992 (0.005)	0.989 (0.007)	0.99 (0.006)	0.991 (0.005)	0.992 (0.005)
		Th2	0.99 (0.007)	0.991 (0.005)	0.991 (0.005)	0.992 (0.005)	0.988 (0.008)	0.99 (0.006)	0.991 (0.005)	0.992 (0.005)
NC=50										
	CS=10	Th1	0.983 (0.018)	0.979 (0.016)	0.977 (0.014)	0.975 (0.013)	0.978 (0.023)	0.972 (0.021)	0.968 (0.02)	0.966 (0.019)
		Th2	0.985 (0.019)	0.979 (0.016)	0.976 (0.014)	0.975 (0.014)	0.981 (0.024)	0.972 (0.021)	0.967 (0.019)	0.965 (0.019)
	CS=50	Th1	0.981 (0.008)	0.98 (0.006)	0.979 (0.006)	0.979 (0.005)	0.974 (0.011)	0.973 (0.009)	0.973 (0.008)	0.973 (0.008)
		Th2	0.982 (0.008)	0.98 (0.006)	0.98 (0.006)	0.979 (0.005)	0.975 (0.012)	0.973 (0.009)	0.974 (0.008)	0.974 (0.007)
	CS=100	Th1	0.984 (0.005)	0.984 (0.004)	0.985 (0.004)	0.986 (0.004)	0.981 (0.007)	0.983 (0.005)	0.984 (0.004)	0.985 (0.004)
		Th2	0.984 (0.005)	0.985 (0.004)	0.985 (0.004)	0.986 (0.004)	0.981 (0.007)	0.983 (0.005)	0.985 (0.004)	0.985 (0.004)
NC=100										
	CS=10	Th1	0.982 (0.013)	0.979 (0.01)	0.977 (0.009)	0.976 (0.009)	0.975 (0.017)	0.97 (0.015)	0.967 (0.014)	0.965 (0.014)
		Th2	0.982 (0.013)	0.979 (0.01)	0.977 (0.009)	0.976 (0.009)	0.977 (0.017)	0.97 (0.015)	0.966 (0.014)	0.965 (0.013)
	CS=50	Th1	0.979 (0.005)	0.978 (0.004)	0.977 (0.004)	0.977 (0.004)	0.968 (0.008)	0.966 (0.008)	0.965 (0.007)	0.965 (0.007)
		Th2	0.98 (0.006)	0.978 (0.004)	0.977 (0.004)	0.977 (0.004)	0.97 (0.009)	0.966 (0.008)	0.965 (0.007)	0.965 (0.007)
	CS=100	Th1	0.98 (0.004)	0.98 (0.003)	0.98 (0.003)	0.98 (0.003)	0.972 (0.006)	0.974 (0.005)	0.976 (0.005)	0.977 (0.004)
		Th2	0.98 (0.004)	0.98 (0.003)	0.98 (0.003)	0.981 (0.003)	0.972 (0.006)	0.975 (0.005)	0.977 (0.004)	0.978 (0.004)

Note. MWc = Complex misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-13

TLI Means and Standard Deviations (in parenthesis) for the MWc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.987 (0.047)	0.976 (0.036)	0.968 (0.029)	0.964 (0.028)	0.983 (0.06)	0.968 (0.047)	0.958 (0.039)	0.953 (0.037)
		Th2	0.987 (0.061)	0.976 (0.035)	0.969 (0.028)	0.965 (0.027)	0.983 (0.076)	0.968 (0.046)	0.959 (0.038)	0.954 (0.036)
	CS=50	Th1	1.017 (0.018)	1.015 (0.014)	1.013 (0.012)	1.013 (0.012)	1.018 (0.019)	1.014 (0.014)	1.013 (0.012)	1.013 (0.012)
		Th2	1.022 (0.021)	1.017 (0.014)	1.014 (0.011)	1.014 (0.011)	1.023 (0.021)	1.017 (0.014)	1.013 (0.011)	1.013 (0.011)
	CS=100	Th1	1.047 (0.019)	1.041 (0.018)	1.038 (0.017)	1.038 (0.017)	1.046 (0.019)	1.041 (0.018)	1.038 (0.018)	1.039 (0.018)
		Th2	1.054 (0.021)	1.043 (0.019)	1.037 (0.018)	1.038 (0.018)	1.053 (0.021)	1.043 (0.019)	1.038 (0.019)	1.039 (0.019)
NC=50										
	CS=10	Th1	0.979 (0.032)	0.974 (0.024)	0.969 (0.021)	0.967 (0.019)	0.972 (0.043)	0.964 (0.034)	0.956 (0.03)	0.953 (0.028)
		Th2	0.981 (0.035)	0.973 (0.024)	0.968 (0.02)	0.966 (0.019)	0.975 (0.047)	0.963 (0.034)	0.955 (0.029)	0.952 (0.028)
	CS=50	Th1	0.991 (0.01)	0.991 (0.008)	0.991 (0.007)	0.991 (0.007)	0.99 (0.012)	0.99 (0.009)	0.991 (0.007)	0.991 (0.007)
		Th2	0.994 (0.012)	0.992 (0.008)	0.992 (0.007)	0.992 (0.006)	0.993 (0.014)	0.992 (0.008)	0.992 (0.007)	0.992 (0.006)
	CS=100	Th1	1.006 (0.009)	1.005 (0.007)	1.004 (0.006)	1.004 (0.006)	1.006 (0.008)	1.005 (0.007)	1.004 (0.006)	1.004 (0.006)
		Th2	1.01 (0.01)	1.006 (0.007)	1.004 (0.006)	1.004 (0.006)	1.009 (0.009)	1.006 (0.007)	1.004 (0.006)	1.004 (0.006)
NC=100										
	CS=10	Th1	0.977 (0.018)	0.973 (0.014)	0.969 (0.013)	0.968 (0.013)	0.966 (0.027)	0.959 (0.022)	0.953 (0.021)	0.951 (0.02)
		Th2	0.978 (0.02)	0.973 (0.015)	0.969 (0.013)	0.968 (0.012)	0.968 (0.028)	0.959 (0.023)	0.952 (0.02)	0.95 (0.02)
	CS=50	Th1	0.978 (0.007)	0.978 (0.006)	0.978 (0.005)	0.979 (0.005)	0.971 (0.01)	0.974 (0.007)	0.976 (0.006)	0.977 (0.006)
		Th2	0.979 (0.007)	0.978 (0.006)	0.979 (0.005)	0.979 (0.004)	0.972 (0.01)	0.975 (0.007)	0.977 (0.005)	0.978 (0.005)
	CS=100	Th1	0.985 (0.005)	0.986 (0.004)	0.987 (0.003)	0.987 (0.003)	0.985 (0.005)	0.986 (0.004)	0.987 (0.003)	0.987 (0.003)
		Th2	0.987 (0.005)	0.987 (0.004)	0.987 (0.003)	0.987 (0.003)	0.986 (0.005)	0.987 (0.004)	0.987 (0.003)	0.988 (0.003)
Low-ICC										
NC=30										
	CS=10	Th1	1.004 (0.051)	0.979 (0.034)	0.969 (0.029)	0.965 (0.027)	1.002 (0.06)	0.973 (0.042)	0.961 (0.037)	0.955 (0.035)
		Th2	1.019 (0.063)	0.981 (0.035)	0.969 (0.027)	0.965 (0.026)	1.019 (0.072)	0.975 (0.043)	0.961 (0.035)	0.955 (0.034)
	CS=50	Th1	0.978 (0.014)	0.977 (0.011)	0.977 (0.01)	0.977 (0.009)	0.972 (0.019)	0.972 (0.014)	0.972 (0.012)	0.973 (0.011)
		Th2	0.98 (0.016)	0.977 (0.011)	0.977 (0.009)	0.977 (0.009)	0.975 (0.02)	0.972 (0.014)	0.973 (0.012)	0.974 (0.011)

Table B-13 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.986 (0.009)	0.987 (0.008)	0.988 (0.007)	0.989 (0.006)	0.985 (0.01)	0.986 (0.008)	0.988 (0.007)	0.989 (0.007)
		Th2	0.986 (0.01)	0.987 (0.007)	0.988 (0.006)	0.989 (0.007)	0.984 (0.012)	0.987 (0.008)	0.988 (0.007)	0.989 (0.007)
NC=50										
	CS=10	Th1	0.981 (0.029)	0.972 (0.022)	0.968 (0.02)	0.966 (0.018)	0.976 (0.037)	0.963 (0.03)	0.957 (0.027)	0.953 (0.026)
		Th2	0.987 (0.034)	0.972 (0.023)	0.968 (0.019)	0.966 (0.019)	0.983 (0.043)	0.963 (0.03)	0.956 (0.027)	0.953 (0.026)
	CS=50	Th1	0.974 (0.01)	0.972 (0.009)	0.972 (0.008)	0.972 (0.007)	0.964 (0.015)	0.963 (0.013)	0.963 (0.011)	0.964 (0.01)
		Th2	0.975 (0.011)	0.973 (0.008)	0.972 (0.008)	0.972 (0.007)	0.966 (0.016)	0.963 (0.012)	0.964 (0.011)	0.964 (0.01)
	CS=100	Th1	0.978 (0.007)	0.979 (0.006)	0.979 (0.005)	0.98 (0.005)	0.974 (0.009)	0.976 (0.007)	0.978 (0.006)	0.98 (0.006)
		Th2	0.979 (0.007)	0.979 (0.006)	0.98 (0.005)	0.98 (0.005)	0.974 (0.01)	0.977 (0.007)	0.979 (0.006)	0.98 (0.006)
NC=100										
	CS=10	Th1	0.975 (0.018)	0.971 (0.014)	0.969 (0.013)	0.968 (0.012)	0.966 (0.024)	0.959 (0.02)	0.954 (0.019)	0.952 (0.018)
		Th2	0.977 (0.019)	0.972 (0.014)	0.969 (0.012)	0.968 (0.012)	0.969 (0.024)	0.96 (0.02)	0.954 (0.019)	0.952 (0.018)
	CS=50	Th1	0.971 (0.007)	0.969 (0.006)	0.968 (0.006)	0.968 (0.005)	0.957 (0.011)	0.953 (0.01)	0.953 (0.01)	0.953 (0.009)
		Th2	0.972 (0.008)	0.969 (0.006)	0.968 (0.006)	0.968 (0.005)	0.958 (0.012)	0.954 (0.01)	0.953 (0.009)	0.953 (0.009)
	CS=100	Th1	0.973 (0.005)	0.973 (0.004)	0.973 (0.004)	0.973 (0.004)	0.962 (0.008)	0.965 (0.007)	0.968 (0.006)	0.969 (0.006)
		Th2	0.973 (0.005)	0.973 (0.004)	0.973 (0.004)	0.974 (0.004)	0.962 (0.009)	0.966 (0.007)	0.969 (0.006)	0.97 (0.006)

Note. MWc = Complex misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-14

RMSEA Means and Standard Deviations (in parenthesis) for the MWc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.014 (0.014)	0.022 (0.016)	0.031 (0.017)	0.037 (0.017)	0.01 (0.01)	0.016 (0.012)	0.022 (0.012)	0.027 (0.012)
		Th2	0.014 (0.015)	0.022 (0.016)	0.032 (0.017)	0.038 (0.017)	0.01 (0.011)	0.016 (0.012)	0.023 (0.012)	0.027 (0.012)
	CS=50	Th1	0.002 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
		Th2	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.016 (0.013)	0.023 (0.013)	0.031 (0.012)	0.035 (0.012)	0.012 (0.01)	0.018 (0.01)	0.024 (0.01)	0.028 (0.009)
		Th2	0.014 (0.012)	0.023 (0.013)	0.033 (0.012)	0.037 (0.012)	0.011 (0.01)	0.018 (0.01)	0.026 (0.009)	0.029 (0.009)
	CS=50	Th1	0.009 (0.006)	0.011 (0.006)	0.012 (0.006)	0.012 (0.006)	0.006 (0.004)	0.007 (0.004)	0.007 (0.004)	0.008 (0.004)
		Th2	0.007 (0.006)	0.01 (0.006)	0.012 (0.006)	0.012 (0.006)	0.005 (0.004)	0.006 (0.004)	0.007 (0.004)	0.008 (0.004)
	CS=100	Th1	0.001 (0.002)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.001)	0.001 (0.001)	0.001 (0.002)	0.001 (0.002)
		Th2	0.001 (0.002)	0.001 (0.002)	0.001 (0.003)	0.001 (0.003)	0 (0.001)	0.001 (0.001)	0.001 (0.002)	0.001 (0.002)
NC=100										
	CS=10	Th1	0.018 (0.008)	0.025 (0.007)	0.031 (0.007)	0.034 (0.007)	0.015 (0.007)	0.021 (0.006)	0.026 (0.006)	0.029 (0.006)
		Th2	0.016 (0.009)	0.025 (0.008)	0.034 (0.007)	0.036 (0.007)	0.013 (0.007)	0.021 (0.007)	0.028 (0.006)	0.03 (0.006)
	CS=50	Th1	0.016 (0.003)	0.02 (0.003)	0.022 (0.003)	0.023 (0.003)	0.012 (0.002)	0.014 (0.002)	0.015 (0.002)	0.015 (0.002)
		Th2	0.015 (0.003)	0.02 (0.003)	0.023 (0.003)	0.024 (0.003)	0.011 (0.002)	0.014 (0.002)	0.015 (0.002)	0.016 (0.002)
	CS=100	Th1	0.011 (0.002)	0.012 (0.002)	0.013 (0.002)	0.014 (0.002)	0.007 (0.001)	0.007 (0.001)	0.008 (0.001)	0.008 (0.001)
		Th2	0.01 (0.002)	0.012 (0.002)	0.013 (0.002)	0.014 (0.002)	0.006 (0.001)	0.007 (0.001)	0.008 (0.001)	0.008 (0.001)
Low-ICC										
NC=30										
	CS=10	Th1	0.011 (0.014)	0.021 (0.017)	0.032 (0.017)	0.039 (0.017)	0.008 (0.01)	0.015 (0.012)	0.023 (0.012)	0.028 (0.012)
		Th2	0.009 (0.013)	0.021 (0.017)	0.033 (0.018)	0.039 (0.017)	0.006 (0.009)	0.015 (0.012)	0.024 (0.013)	0.028 (0.012)
	CS=50	Th1	0.018 (0.007)	0.023 (0.007)	0.028 (0.007)	0.03 (0.007)	0.013 (0.005)	0.016 (0.005)	0.019 (0.005)	0.02 (0.005)
		Th2	0.015 (0.007)	0.023 (0.007)	0.028 (0.007)	0.03 (0.007)	0.011 (0.005)	0.016 (0.005)	0.019 (0.005)	0.02 (0.005)

Table B-14 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.012 (0.005)	0.015 (0.005)	0.016 (0.006)	0.017 (0.006)	0.008 (0.004)	0.009 (0.004)	0.01 (0.004)	0.01 (0.004)
		Th2	0.011 (0.006)	0.014 (0.006)	0.016 (0.006)	0.017 (0.006)	0.007 (0.004)	0.009 (0.004)	0.01 (0.004)	0.01 (0.004)
NC=50										
	CS=10	Th1	0.016 (0.012)	0.025 (0.012)	0.033 (0.011)	0.038 (0.011)	0.013 (0.009)	0.02 (0.009)	0.025 (0.009)	0.029 (0.008)
		Th2	0.013 (0.012)	0.025 (0.012)	0.035 (0.012)	0.039 (0.011)	0.01 (0.009)	0.02 (0.01)	0.027 (0.009)	0.03 (0.009)
	CS=50	Th1	0.02 (0.004)	0.026 (0.004)	0.031 (0.005)	0.033 (0.005)	0.016 (0.003)	0.02 (0.003)	0.023 (0.004)	0.025 (0.004)
		Th2	0.018 (0.005)	0.026 (0.004)	0.032 (0.005)	0.034 (0.005)	0.014 (0.004)	0.02 (0.003)	0.024 (0.004)	0.025 (0.004)
	CS=100	Th1	0.017 (0.003)	0.02 (0.003)	0.023 (0.003)	0.024 (0.004)	0.012 (0.002)	0.014 (0.003)	0.015 (0.003)	0.015 (0.003)
		Th2	0.016 (0.003)	0.02 (0.003)	0.023 (0.004)	0.024 (0.004)	0.011 (0.002)	0.013 (0.003)	0.015 (0.003)	0.015 (0.003)
NC=100										
	CS=10	Th1	0.019 (0.008)	0.027 (0.008)	0.033 (0.007)	0.036 (0.007)	0.016 (0.007)	0.022 (0.006)	0.027 (0.006)	0.03 (0.006)
		Th2	0.017 (0.008)	0.027 (0.007)	0.034 (0.007)	0.037 (0.007)	0.014 (0.007)	0.022 (0.006)	0.029 (0.006)	0.031 (0.006)
	CS=50	Th1	0.022 (0.003)	0.028 (0.003)	0.033 (0.003)	0.035 (0.003)	0.018 (0.002)	0.023 (0.002)	0.027 (0.003)	0.029 (0.003)
		Th2	0.02 (0.003)	0.028 (0.003)	0.034 (0.003)	0.036 (0.003)	0.017 (0.002)	0.023 (0.002)	0.028 (0.003)	0.029 (0.003)
	CS=100	Th1	0.02 (0.002)	0.024 (0.002)	0.027 (0.002)	0.029 (0.003)	0.016 (0.002)	0.018 (0.002)	0.02 (0.002)	0.02 (0.003)
		Th2	0.018 (0.002)	0.024 (0.002)	0.028 (0.003)	0.029 (0.003)	0.015 (0.002)	0.018 (0.002)	0.02 (0.002)	0.02 (0.003)

Note. MWc = Complex misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-15

SRMR-Within Means and Standard Deviations (in parenthesis) for the MWc by ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
NC=30										
	CS=10	Th1	0.082 (0.011)	0.065 (0.009)	0.057 (0.008)	0.054 (0.008)	0.072 (0.010)	0.060 (0.008)	0.053 (0.008)	0.051 (0.007)
		Th2	0.089 (0.013)	0.064 (0.009)	0.054 (0.008)	0.052 (0.007)	0.081 (0.011)	0.059 (0.008)	0.051 (0.007)	0.050 (0.007)
	CS=50	Th1	0.046 (0.006)	0.041 (0.005)	0.039 (0.004)	0.039 (0.005)	0.042 (0.005)	0.038 (0.005)	0.037 (0.004)	0.037 (0.004)
		Th2	0.048 (0.006)	0.041 (0.005)	0.038 (0.004)	0.038 (0.004)	0.044 (0.006)	0.038 (0.005)	0.036 (0.004)	0.036 (0.004)
	CS=100	Th1	0.041 (0.005)	0.039 (0.004)	0.038 (0.004)	0.038 (0.004)	0.038 (0.005)	0.037 (0.004)	0.037 (0.004)	0.037 (0.004)
		Th2	0.042 (0.005)	0.039 (0.004)	0.038 (0.004)	0.038 (0.004)	0.040 (0.005)	0.037 (0.004)	0.037 (0.004)	0.038 (0.005)
NC=50										
	CS=10	Th1	0.066 (0.009)	0.053 (0.007)	0.047 (0.006)	0.045 (0.006)	0.059 (0.008)	0.050 (0.007)	0.045 (0.006)	0.043 (0.006)
		Th2	0.071 (0.009)	0.053 (0.007)	0.045 (0.006)	0.044 (0.006)	0.064 (0.009)	0.050 (0.007)	0.044 (0.006)	0.043 (0.006)
	CS=50	Th1	0.040 (0.004)	0.037 (0.004)	0.036 (0.004)	0.035 (0.003)	0.037 (0.004)	0.035 (0.004)	0.034 (0.003)	0.034 (0.003)
		Th2	0.041 (0.005)	0.037 (0.004)	0.035 (0.003)	0.035 (0.003)	0.039 (0.005)	0.035 (0.004)	0.034 (0.003)	0.034 (0.003)
	CS=100	Th1	0.037 (0.004)	0.036 (0.003)	0.036 (0.003)	0.036 (0.003)	0.035 (0.003)	0.035 (0.003)	0.035 (0.003)	0.035 (0.003)
		Th2	0.038 (0.004)	0.036 (0.003)	0.035 (0.003)	0.035 (0.003)	0.036 (0.004)	0.035 (0.003)	0.035 (0.003)	0.035 (0.003)
NC=100										
	CS=10	Th1	0.051 (0.007)	0.043 (0.005)	0.040 (0.005)	0.038 (0.005)	0.046 (0.006)	0.041 (0.005)	0.038 (0.005)	0.037 (0.005)
		Th2	0.054 (0.007)	0.043 (0.006)	0.038 (0.005)	0.038 (0.005)	0.050 (0.006)	0.041 (0.005)	0.037 (0.005)	0.037 (0.004)
	CS=50	Th1	0.035 (0.003)	0.033 (0.003)	0.033 (0.002)	0.033 (0.002)	0.034 (0.003)	0.032 (0.003)	0.032 (0.002)	0.032 (0.002)
		Th2	0.036 (0.004)	0.033 (0.003)	0.033 (0.002)	0.033 (0.002)	0.034 (0.003)	0.032 (0.003)	0.032 (0.002)	0.032 (0.002)
	CS=100	Th1	0.034 (0.003)	0.033 (0.002)	0.033 (0.002)	0.033 (0.002)	0.033 (0.002)	0.032 (0.002)	0.032 (0.002)	0.032 (0.002)
		Th2	0.034 (0.003)	0.033 (0.002)	0.033 (0.002)	0.033 (0.002)	0.033 (0.003)	0.032 (0.002)	0.032 (0.002)	0.033 (0.002)

Note. MWc = Complex misspecified within-level model. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-16

Chi-Square Means and Standard Deviations (in parenthesis) for the MWBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	75.07 (14.89)	83.58 (17.77)	95.33 (21.32)	103.64 (24.23)	71.63 (7.66)	76.01 (9.12)	82.06 (10.95)	86.34 (12.47)
		Th2	74.9 (16.79)	83.91 (18.07)	97.43 (23.35)	104.82 (24.87)	71.49 (8.49)	76.14 (9.23)	83.09 (11.94)	86.87 (12.72)
	CS=50	Th1	56.51 (15.04)	54.2 (15.58)	52.06 (15.84)	50.42 (15.92)	63.86 (5.72)	63.49 (5.35)	63.02 (5.13)	62.55 (5.08)
		Th2	54.51 (14.79)	51.14 (14.79)	50.04 (15.4)	49.28 (15.64)	63.05 (5.59)	62.55 (4.87)	62.46 (4.86)	62.24 (4.92)
	CS=100	Th1	30.87 (9.71)	27.81 (9.36)	25.63 (8.92)	24.24 (8.4)	57.07 (2.61)	56.61 (2.45)	56 (2.37)	55.42 (2.32)
		Th2	29.46 (9.48)	26.34 (8.89)	24.91 (8.29)	23.73 (8.45)	56.64 (2.56)	56.24 (2.33)	55.79 (2.22)	55.3 (2.32)
NC=50										
	CS=10	Th1	83.98 (17.56)	95.45 (20.57)	110.99 (24.66)	120.98 (27.38)	77.62 (10.56)	84.5 (12.31)	93.79 (14.72)	99.8 (16.37)
		Th2	81.3 (17.21)	96.73 (21.12)	116.5 (26.76)	124.82 (28.8)	75.89 (10.22)	85.15 (12.55)	97 (15.9)	102.01 (17.14)
	CS=50	Th1	89.8 (19.44)	96.3 (22.17)	100.77 (23.46)	103.03 (24.53)	78.35 (9.4)	79.8 (9.63)	80.53 (9.35)	80.95 (9.46)
		Th2	83.84 (19.34)	93.13 (20.91)	100.98 (23.7)	102.72 (24.55)	75.69 (9.4)	78.22 (8.8)	80.25 (9.19)	80.65 (9.33)
	CS=100	Th1	60.65 (15.18)	60.17 (15.96)	60.18 (16.24)	59.61 (16.29)	65.81 (4.97)	65.77 (4.91)	65.8 (4.86)	65.6 (4.89)
		Th2	55.9 (14.82)	57.68 (15.27)	60 (16.32)	59.4 (16.4)	64.23 (4.81)	65.02 (4.63)	65.74 (4.87)	65.55 (4.91)
NC=100										
	CS=10	Th1	103.31 (20.74)	124.91 (24.73)	149.89 (30.05)	164.2 (33.62)	92.97 (14.63)	108.07 (17.35)	125.43 (20.99)	135.37 (23.42)
		Th2	98.17 (19.46)	126.89 (26.38)	160.86 (32.89)	171.8 (35)	89.12 (13.6)	109.2 (18.38)	132.89 (22.82)	140.55 (24.31)
	CS=50	Th1	172.63 (30.19)	213.04 (36.39)	245.61 (40.1)	261.86 (44.33)	129.48 (18.94)	142.3 (21.38)	150.15 (21.86)	154 (23.16)
		Th2	156.82 (28.13)	211.87 (36.23)	256.06 (41.69)	267 (44.15)	120.34 (17.61)	139.47 (20.47)	151.15 (21.65)	153.88 (22.63)
	CS=100	Th1	155.08 (29.04)	176.9 (33.81)	192.79 (37.28)	199.07 (40.59)	102.08 (12.83)	106.37 (13.59)	109.58 (13.84)	111.01 (14.69)
		Th2	141.3 (27.22)	171.18 (34.06)	195.06 (38.82)	198.31 (40.02)	97.02 (11.98)	103.65 (13.31)	109.57 (14.15)	110.28 (14.36)
Low-ICC										
NC=30										
	CS=10	Th1	69.4 (16.75)	81.51 (18.79)	95.4 (23.4)	105.6 (26.4)	68.95 (8.26)	75 (9.55)	82.08 (11.98)	87.36 (13.6)
		Th2	64.11 (16.45)	81.25 (20.1)	97.49 (24.03)	106.87 (26.73)	66.45 (7.86)	74.86 (10.12)	83.17 (12.32)	88.05 (13.81)
	CS=50	Th1	106.58 (24.06)	129.12 (29.88)	152.51 (36.3)	166 (40.7)	87.52 (12.26)	97.71 (15.06)	107.31 (18.05)	112.67 (20.12)
		Th2	98.51 (22.1)	128.25 (29.51)	155.75 (37.37)	167.11 (42.16)	83.46 (11.25)	97.06 (14.8)	108.2 (18.53)	112.7 (20.92)

Table B-16 *Continued*

Number of Cluster	Cluster Size	TH	WLSM				WLSMV			
			2-cat	3-cat	5-cat	7-cat	2-cat	3-cat	5-cat	7-cat
	CS=100	Th1	107.05 (25.41)	119.53 (30.42)	129.74 (36.3)	131.62 (39.29)	84.77 (11.53)	87.98 (13.05)	90.42 (14.68)	90.57 (15.34)
		Th2	101.39 (24.42)	117.47 (30.45)	129.6 (37.21)	132.91 (41.43)	82.66 (11.25)	87.02 (12.87)	89.95 (14.94)	90.75 (15.74)
NC=50										
	CS=10	Th1	81.38 (17.15)	95.93 (19.83)	110.82 (23.76)	122.66 (26.7)	76.15 (10.3)	84.87 (11.92)	93.8 (14.26)	100.97 (16.01)
		Th2	76.13 (16.67)	96.33 (21.06)	115.92 (26.12)	125.51 (28.35)	72.96 (9.81)	85.03 (12.61)	96.82 (15.66)	102.65 (17.04)
	CS=50	Th1	145.12 (29.27)	190.79 (38.26)	235.14 (47.05)	260.97 (50.16)	113.89 (17.51)	138.7 (22.82)	160.5 (27.93)	172.34 (29.51)
		Th2	131.79 (27.06)	189.18 (36.07)	245.22 (47.7)	267.52 (52.53)	105.96 (16.13)	137.11 (21.12)	164.26 (28.13)	174.73 (30.9)
	CS=100	Th1	174.58 (35.03)	213.86 (44.82)	249.3 (52.81)	262 (58.53)	121.73 (20.13)	133.37 (24.51)	143.03 (27.45)	145.43 (29.02)
		Th2	157.3 (31.04)	210.33 (43.16)	253.96 (56.46)	265.41 (59.93)	113.58 (17.75)	131.02 (23.31)	142.93 (28.3)	145.7 (29.37)
NC=100										
	CS=10	Th1	100.44 (19.93)	123.52 (25.04)	147.7 (29.87)	161.94 (32.84)	91.23 (14.23)	107.43 (17.67)	124.3 (20.93)	134.27 (22.92)
		Th2	93.71 (17.86)	123.8 (25.55)	155.36 (31.91)	167.09 (33.93)	86.27 (12.65)	107.47 (17.93)	129.53 (22.28)	137.78 (23.64)
	CS=50	Th1	243.1 (39.38)	345.71 (52.73)	443.79 (66.91)	496.95 (73.26)	190.92 (27.59)	259.13 (36.78)	320.09 (46.9)	351.99 (52.03)
		Th2	212.14 (37.05)	344.95 (53.34)	471.63 (69.93)	514.52 (76.06)	169.25 (25.99)	257.31 (37.09)	335.01 (49.04)	360.48 (53.95)
	CS=100	Th1	351.18 (53.15)	479.28 (72.52)	586.81 (89.89)	636.99 (104.4)	243.84 (39.06)	297.83 (52.21)	333.6 (64.01)	345.94 (69.53)
		Th2	305.79 (48.35)	472.38 (73.43)	608.83 (95.27)	649.69 (104.9)	217.79 (34.14)	290.03 (52.66)	335.68 (65.56)	346.36 (68.49)

Note. MWBc = Complex misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-17

CFI Means and Standard Deviations (in parenthesis) for the MWBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.977 (0.027)	0.975 (0.024)	0.972 (0.021)	0.97 (0.021)	0.972 (0.034)	0.968 (0.031)	0.964 (0.027)	0.962 (0.027)
		Th2	0.973 (0.035)	0.976 (0.023)	0.973 (0.021)	0.971 (0.02)	0.967 (0.043)	0.969 (0.03)	0.966 (0.027)	0.963 (0.026)
	CS=50	Th1	0.998 (0.005)	0.999 (0.003)	0.999 (0.002)	0.999 (0.002)	0.998 (0.005)	0.999 (0.003)	0.999 (0.002)	0.999 (0.002)
		Th2	0.999 (0.005)	0.999 (0.002)	1 (0.002)	1 (0.002)	0.998 (0.005)	0.999 (0.002)	1 (0.002)	1 (0.002)
	CS=100	Th1	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
		Th2	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
NC=50										
	CS=10	Th1	0.976 (0.022)	0.975 (0.018)	0.973 (0.016)	0.972 (0.015)	0.969 (0.029)	0.966 (0.025)	0.962 (0.022)	0.96 (0.021)
		Th2	0.977 (0.023)	0.975 (0.018)	0.973 (0.015)	0.972 (0.014)	0.97 (0.031)	0.966 (0.024)	0.962 (0.021)	0.96 (0.02)
	CS=50	Th1	0.991 (0.007)	0.991 (0.006)	0.992 (0.005)	0.993 (0.005)	0.989 (0.008)	0.991 (0.006)	0.992 (0.005)	0.993 (0.005)
		Th2	0.992 (0.008)	0.992 (0.005)	0.993 (0.005)	0.993 (0.005)	0.991 (0.009)	0.992 (0.006)	0.993 (0.005)	0.993 (0.004)
	CS=100	Th1	0.999 (0.002)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)	0.999 (0.002)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)
		Th2	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)	0.999 (0.002)	0.999 (0.002)	0.999 (0.001)	0.999 (0.001)
NC=100										
	CS=10	Th1	0.976 (0.014)	0.975 (0.011)	0.973 (0.01)	0.973 (0.01)	0.965 (0.02)	0.962 (0.017)	0.959 (0.016)	0.958 (0.015)
		Th2	0.977 (0.015)	0.975 (0.011)	0.973 (0.01)	0.973 (0.009)	0.967 (0.021)	0.962 (0.017)	0.958 (0.015)	0.957 (0.015)
	CS=50	Th1	0.981 (0.005)	0.982 (0.004)	0.983 (0.004)	0.983 (0.003)	0.975 (0.007)	0.979 (0.005)	0.981 (0.004)	0.982 (0.004)
		Th2	0.982 (0.006)	0.982 (0.004)	0.983 (0.003)	0.983 (0.003)	0.976 (0.008)	0.98 (0.005)	0.982 (0.004)	0.983 (0.004)
	CS=100	Th1	0.988 (0.004)	0.989 (0.003)	0.989 (0.002)	0.99 (0.002)	0.988 (0.004)	0.989 (0.003)	0.99 (0.002)	0.99 (0.002)
		Th2	0.988 (0.004)	0.989 (0.003)	0.99 (0.002)	0.99 (0.002)	0.988 (0.004)	0.99 (0.003)	0.99 (0.002)	0.991 (0.002)
Low-ICC										
NC=30										
	CS=10	Th1	0.985 (0.022)	0.98 (0.021)	0.975 (0.021)	0.972 (0.02)	0.982 (0.027)	0.975 (0.027)	0.968 (0.026)	0.964 (0.025)
		Th2	0.988 (0.024)	0.98 (0.022)	0.975 (0.019)	0.972 (0.019)	0.985 (0.028)	0.975 (0.027)	0.969 (0.025)	0.965 (0.025)
	CS=50	Th1	0.982 (0.011)	0.982 (0.008)	0.982 (0.007)	0.982 (0.007)	0.978 (0.013)	0.978 (0.01)	0.979 (0.009)	0.98 (0.008)
		Th2	0.984 (0.011)	0.982 (0.008)	0.983 (0.007)	0.983 (0.007)	0.979 (0.014)	0.979 (0.01)	0.98 (0.008)	0.98 (0.008)

Table B-17 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.989 (0.007)	0.99 (0.005)	0.991 (0.005)	0.991 (0.005)	0.988 (0.008)	0.989 (0.006)	0.991 (0.005)	0.991 (0.005)
		Th2	0.989 (0.007)	0.99 (0.005)	0.991 (0.005)	0.991 (0.005)	0.987 (0.008)	0.99 (0.006)	0.991 (0.005)	0.991 (0.005)
NC=50										
	CS=10	Th1	0.981 (0.019)	0.977 (0.016)	0.975 (0.014)	0.973 (0.013)	0.976 (0.024)	0.97 (0.021)	0.966 (0.02)	0.963 (0.019)
		Th2	0.983 (0.021)	0.977 (0.016)	0.974 (0.014)	0.973 (0.014)	0.979 (0.025)	0.97 (0.022)	0.965 (0.019)	0.963 (0.019)
	CS=50	Th1	0.979 (0.008)	0.979 (0.006)	0.978 (0.006)	0.978 (0.005)	0.972 (0.011)	0.971 (0.009)	0.972 (0.008)	0.973 (0.007)
		Th2	0.98 (0.008)	0.979 (0.006)	0.979 (0.006)	0.979 (0.005)	0.973 (0.012)	0.972 (0.009)	0.973 (0.008)	0.973 (0.007)
	CS=100	Th1	0.983 (0.005)	0.984 (0.004)	0.984 (0.004)	0.985 (0.004)	0.98 (0.007)	0.982 (0.005)	0.984 (0.004)	0.985 (0.004)
		Th2	0.983 (0.005)	0.984 (0.004)	0.985 (0.004)	0.985 (0.004)	0.98 (0.007)	0.983 (0.005)	0.985 (0.004)	0.985 (0.004)
NC=100										
	CS=10	Th1	0.979 (0.013)	0.977 (0.01)	0.975 (0.009)	0.975 (0.009)	0.972 (0.017)	0.967 (0.015)	0.964 (0.014)	0.962 (0.013)
		Th2	0.98 (0.013)	0.977 (0.011)	0.975 (0.009)	0.974 (0.009)	0.974 (0.017)	0.967 (0.015)	0.964 (0.014)	0.962 (0.013)
	CS=50	Th1	0.977 (0.005)	0.976 (0.004)	0.976 (0.004)	0.976 (0.004)	0.966 (0.008)	0.964 (0.007)	0.964 (0.007)	0.964 (0.007)
		Th2	0.978 (0.006)	0.976 (0.004)	0.976 (0.004)	0.976 (0.004)	0.967 (0.009)	0.964 (0.007)	0.964 (0.007)	0.964 (0.007)
	CS=100	Th1	0.979 (0.004)	0.979 (0.003)	0.98 (0.003)	0.98 (0.003)	0.971 (0.006)	0.974 (0.005)	0.976 (0.005)	0.977 (0.004)
		Th2	0.979 (0.004)	0.979 (0.003)	0.98 (0.003)	0.98 (0.003)	0.971 (0.006)	0.974 (0.005)	0.977 (0.004)	0.978 (0.004)

Note. MWBc = Complex misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-18

TLI Means and Standard Deviations (in parenthesis) for the MWBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.979 (0.046)	0.97 (0.035)	0.964 (0.029)	0.961 (0.028)	0.974 (0.058)	0.962 (0.046)	0.954 (0.038)	0.95 (0.036)
		Th2	0.977 (0.06)	0.971 (0.035)	0.966 (0.028)	0.962 (0.027)	0.972 (0.074)	0.962 (0.045)	0.955 (0.037)	0.951 (0.035)
	CS=50	Th1	1.014 (0.018)	1.013 (0.014)	1.012 (0.012)	1.013 (0.012)	1.014 (0.018)	1.012 (0.014)	1.012 (0.012)	1.012 (0.012)
		Th2	1.018 (0.021)	1.015 (0.014)	1.013 (0.011)	1.013 (0.011)	1.019 (0.021)	1.015 (0.014)	1.012 (0.011)	1.013 (0.011)
	CS=100	Th1	1.045 (0.019)	1.039 (0.018)	1.037 (0.017)	1.037 (0.017)	1.043 (0.019)	1.039 (0.018)	1.037 (0.017)	1.038 (0.018)
		Th2	1.052 (0.021)	1.041 (0.019)	1.037 (0.018)	1.038 (0.018)	1.05 (0.02)	1.041 (0.019)	1.037 (0.019)	1.038 (0.019)
NC=50										
	CS=10	Th1	0.971 (0.032)	0.968 (0.024)	0.964 (0.021)	0.963 (0.019)	0.962 (0.042)	0.956 (0.034)	0.95 (0.029)	0.948 (0.028)
		Th2	0.973 (0.036)	0.968 (0.024)	0.964 (0.02)	0.963 (0.019)	0.965 (0.047)	0.956 (0.033)	0.95 (0.028)	0.948 (0.027)
	CS=50	Th1	0.988 (0.01)	0.989 (0.008)	0.99 (0.007)	0.99 (0.006)	0.987 (0.012)	0.988 (0.009)	0.99 (0.007)	0.99 (0.006)
		Th2	0.99 (0.012)	0.99 (0.008)	0.991 (0.006)	0.991 (0.006)	0.989 (0.014)	0.99 (0.008)	0.991 (0.006)	0.991 (0.006)
	CS=100	Th1	1.005 (0.008)	1.004 (0.007)	1.004 (0.006)	1.004 (0.006)	1.004 (0.008)	1.004 (0.007)	1.003 (0.006)	1.004 (0.006)
		Th2	1.008 (0.009)	1.005 (0.007)	1.003 (0.006)	1.004 (0.006)	1.008 (0.009)	1.005 (0.007)	1.003 (0.006)	1.004 (0.006)
NC=100										
	CS=10	Th1	0.968 (0.019)	0.966 (0.015)	0.965 (0.013)	0.964 (0.013)	0.954 (0.027)	0.95 (0.022)	0.945 (0.021)	0.944 (0.02)
		Th2	0.969 (0.02)	0.967 (0.015)	0.964 (0.013)	0.964 (0.013)	0.957 (0.028)	0.95 (0.023)	0.945 (0.02)	0.943 (0.02)
	CS=50	Th1	0.975 (0.007)	0.976 (0.006)	0.977 (0.005)	0.978 (0.005)	0.967 (0.01)	0.972 (0.007)	0.975 (0.006)	0.976 (0.005)
		Th2	0.976 (0.008)	0.977 (0.006)	0.978 (0.005)	0.978 (0.004)	0.968 (0.01)	0.973 (0.007)	0.977 (0.005)	0.977 (0.005)
	CS=100	Th1	0.984 (0.005)	0.985 (0.004)	0.986 (0.003)	0.987 (0.003)	0.984 (0.005)	0.986 (0.004)	0.987 (0.003)	0.987 (0.003)
		Th2	0.985 (0.005)	0.986 (0.004)	0.987 (0.003)	0.987 (0.003)	0.985 (0.005)	0.986 (0.004)	0.987 (0.003)	0.987 (0.003)
Low-ICC										
NC=30										
	CS=10	Th1	0.998 (0.049)	0.977 (0.033)	0.967 (0.029)	0.963 (0.027)	0.996 (0.057)	0.971 (0.041)	0.959 (0.037)	0.953 (0.034)
		Th2	1.017 (0.062)	0.978 (0.035)	0.968 (0.027)	0.963 (0.026)	1.017 (0.07)	0.972 (0.042)	0.959 (0.034)	0.954 (0.033)
	CS=50	Th1	0.977 (0.014)	0.976 (0.011)	0.976 (0.01)	0.977 (0.009)	0.971 (0.018)	0.971 (0.014)	0.972 (0.012)	0.973 (0.011)
		Th2	0.979 (0.015)	0.977 (0.011)	0.977 (0.009)	0.977 (0.009)	0.973 (0.02)	0.972 (0.014)	0.973 (0.011)	0.974 (0.011)

Table B-18 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.985 (0.009)	0.987 (0.007)	0.988 (0.007)	0.989 (0.006)	0.984 (0.01)	0.986 (0.008)	0.988 (0.007)	0.989 (0.006)
		Th2	0.985 (0.01)	0.987 (0.007)	0.988 (0.006)	0.989 (0.006)	0.984 (0.012)	0.987 (0.008)	0.988 (0.006)	0.989 (0.006)
NC=50										
	CS=10	Th1	0.978 (0.029)	0.97 (0.022)	0.967 (0.019)	0.964 (0.018)	0.972 (0.037)	0.96 (0.029)	0.955 (0.026)	0.952 (0.025)
		Th2	0.984 (0.035)	0.97 (0.022)	0.966 (0.019)	0.964 (0.018)	0.98 (0.042)	0.96 (0.029)	0.954 (0.026)	0.951 (0.025)
	CS=50	Th1	0.973 (0.01)	0.972 (0.009)	0.971 (0.008)	0.971 (0.007)	0.963 (0.014)	0.962 (0.012)	0.963 (0.011)	0.964 (0.01)
		Th2	0.973 (0.011)	0.972 (0.008)	0.972 (0.007)	0.972 (0.007)	0.964 (0.015)	0.963 (0.011)	0.964 (0.01)	0.964 (0.01)
	CS=100	Th1	0.977 (0.007)	0.979 (0.006)	0.979 (0.005)	0.98 (0.005)	0.973 (0.009)	0.977 (0.007)	0.979 (0.006)	0.98 (0.005)
		Th2	0.978 (0.007)	0.979 (0.005)	0.98 (0.005)	0.98 (0.005)	0.973 (0.009)	0.977 (0.007)	0.98 (0.006)	0.98 (0.005)
NC=100										
	CS=10	Th1	0.972 (0.017)	0.969 (0.014)	0.967 (0.012)	0.966 (0.012)	0.963 (0.023)	0.957 (0.02)	0.952 (0.018)	0.95 (0.018)
		Th2	0.974 (0.018)	0.969 (0.014)	0.967 (0.012)	0.966 (0.012)	0.966 (0.024)	0.957 (0.02)	0.952 (0.018)	0.95 (0.018)
	CS=50	Th1	0.97 (0.007)	0.969 (0.006)	0.968 (0.006)	0.968 (0.005)	0.955 (0.011)	0.952 (0.01)	0.952 (0.009)	0.952 (0.009)
		Th2	0.97 (0.007)	0.969 (0.006)	0.968 (0.005)	0.968 (0.005)	0.956 (0.012)	0.953 (0.01)	0.953 (0.009)	0.953 (0.009)
	CS=100	Th1	0.972 (0.005)	0.972 (0.004)	0.973 (0.004)	0.973 (0.004)	0.962 (0.008)	0.965 (0.007)	0.968 (0.006)	0.97 (0.006)
		Th2	0.972 (0.005)	0.973 (0.004)	0.973 (0.004)	0.974 (0.004)	0.962 (0.008)	0.966 (0.007)	0.97 (0.006)	0.97 (0.006)

Note. MWBc = Complex misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-19

RMSEA Means and Standard Deviations (in parenthesis) for the MWBc by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.017 (0.014)	0.024 (0.016)	0.033 (0.016)	0.039 (0.016)	0.012 (0.01)	0.017 (0.011)	0.024 (0.011)	0.028 (0.011)
		Th2	0.016 (0.015)	0.024 (0.016)	0.035 (0.016)	0.04 (0.016)	0.012 (0.011)	0.018 (0.011)	0.025 (0.012)	0.028 (0.011)
	CS=50	Th1	0.002 (0.004)	0.002 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.003)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)
		Th2	0.002 (0.004)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
	CS=100	Th1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.019 (0.012)	0.026 (0.012)	0.034 (0.011)	0.038 (0.011)	0.015 (0.009)	0.02 (0.009)	0.026 (0.009)	0.029 (0.009)
		Th2	0.017 (0.012)	0.027 (0.012)	0.036 (0.011)	0.039 (0.011)	0.013 (0.009)	0.021 (0.009)	0.028 (0.009)	0.03 (0.008)
	CS=50	Th1	0.01 (0.005)	0.012 (0.006)	0.013 (0.006)	0.013 (0.006)	0.007 (0.004)	0.008 (0.004)	0.008 (0.004)	0.008 (0.004)
		Th2	0.008 (0.006)	0.011 (0.006)	0.013 (0.006)	0.013 (0.006)	0.006 (0.004)	0.007 (0.004)	0.008 (0.004)	0.008 (0.004)
	CS=100	Th1	0.002 (0.003)	0.001 (0.003)	0.002 (0.003)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
		Th2	0.001 (0.002)	0.001 (0.002)	0.002 (0.003)	0.001 (0.003)	0.001 (0.001)	0.001 (0.001)	0.001 (0.002)	0.001 (0.002)
NC=100										
	CS=10	Th1	0.022 (0.007)	0.028 (0.007)	0.034 (0.007)	0.037 (0.007)	0.018 (0.006)	0.024 (0.006)	0.029 (0.005)	0.031 (0.006)
		Th2	0.02 (0.008)	0.029 (0.007)	0.036 (0.007)	0.038 (0.007)	0.016 (0.006)	0.024 (0.006)	0.03 (0.006)	0.032 (0.006)
	CS=50	Th1	0.017 (0.003)	0.02 (0.003)	0.023 (0.003)	0.024 (0.003)	0.013 (0.002)	0.015 (0.002)	0.015 (0.002)	0.016 (0.002)
		Th2	0.016 (0.003)	0.02 (0.003)	0.023 (0.003)	0.024 (0.003)	0.012 (0.002)	0.014 (0.002)	0.016 (0.002)	0.016 (0.002)
	CS=100	Th1	0.011 (0.002)	0.013 (0.002)	0.013 (0.002)	0.014 (0.002)	0.007 (0.001)	0.007 (0.001)	0.008 (0.001)	0.008 (0.001)
		Th2	0.01 (0.002)	0.012 (0.002)	0.014 (0.002)	0.014 (0.002)	0.006 (0.001)	0.007 (0.001)	0.008 (0.001)	0.008 (0.001)
Low-ICC										
NC=30										
	CS=10	Th1	0.012 (0.014)	0.022 (0.017)	0.033 (0.017)	0.04 (0.016)	0.009 (0.01)	0.016 (0.012)	0.024 (0.012)	0.029 (0.012)
		Th2	0.008 (0.013)	0.022 (0.017)	0.034 (0.017)	0.041 (0.016)	0.006 (0.009)	0.016 (0.012)	0.025 (0.012)	0.029 (0.012)
	CS=50	Th1	0.018 (0.007)	0.024 (0.006)	0.028 (0.007)	0.03 (0.007)	0.013 (0.005)	0.016 (0.005)	0.019 (0.005)	0.02 (0.005)
		Th2	0.016 (0.007)	0.023 (0.006)	0.029 (0.006)	0.03 (0.007)	0.011 (0.005)	0.016 (0.005)	0.019 (0.005)	0.02 (0.005)

Table B-19 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.013 (0.005)	0.015 (0.005)	0.016 (0.006)	0.017 (0.006)	0.008 (0.003)	0.009 (0.003)	0.01 (0.004)	0.01 (0.004)
		Th2	0.012 (0.005)	0.015 (0.005)	0.016 (0.006)	0.017 (0.006)	0.008 (0.004)	0.009 (0.004)	0.01 (0.004)	0.01 (0.004)
NC=50										
	CS=10	Th1	0.017 (0.012)	0.027 (0.011)	0.034 (0.011)	0.039 (0.01)	0.014 (0.009)	0.021 (0.009)	0.026 (0.008)	0.03 (0.008)
		Th2	0.014 (0.012)	0.027 (0.012)	0.036 (0.011)	0.04 (0.011)	0.01 (0.009)	0.021 (0.009)	0.028 (0.008)	0.031 (0.008)
	CS=50	Th1	0.021 (0.004)	0.027 (0.004)	0.031 (0.004)	0.033 (0.004)	0.016 (0.003)	0.02 (0.003)	0.023 (0.004)	0.025 (0.004)
		Th2	0.019 (0.004)	0.026 (0.004)	0.032 (0.004)	0.034 (0.004)	0.015 (0.003)	0.02 (0.003)	0.024 (0.003)	0.025 (0.004)
	CS=100	Th1	0.017 (0.003)	0.02 (0.003)	0.023 (0.003)	0.024 (0.004)	0.012 (0.002)	0.014 (0.003)	0.015 (0.003)	0.015 (0.003)
		Th2	0.016 (0.003)	0.02 (0.003)	0.023 (0.004)	0.024 (0.004)	0.011 (0.002)	0.013 (0.002)	0.015 (0.003)	0.015 (0.003)
NC=100										
	CS=10	Th1	0.021 (0.008)	0.028 (0.007)	0.034 (0.007)	0.037 (0.007)	0.017 (0.006)	0.023 (0.006)	0.028 (0.005)	0.031 (0.005)
		Th2	0.018 (0.008)	0.028 (0.007)	0.035 (0.007)	0.038 (0.007)	0.015 (0.006)	0.023 (0.006)	0.03 (0.006)	0.032 (0.005)
	CS=50	Th1	0.023 (0.003)	0.028 (0.003)	0.033 (0.003)	0.035 (0.003)	0.019 (0.002)	0.024 (0.002)	0.027 (0.003)	0.029 (0.003)
		Th2	0.02 (0.003)	0.028 (0.003)	0.034 (0.003)	0.036 (0.003)	0.017 (0.002)	0.023 (0.002)	0.028 (0.003)	0.029 (0.003)
	CS=100	Th1	0.02 (0.002)	0.024 (0.002)	0.028 (0.002)	0.029 (0.003)	0.016 (0.002)	0.018 (0.002)	0.02 (0.002)	0.02 (0.003)
		Th2	0.019 (0.002)	0.024 (0.002)	0.028 (0.002)	0.029 (0.003)	0.015 (0.002)	0.018 (0.002)	0.02 (0.002)	0.02 (0.003)

Note. MWBc = Complex misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-20

Chi-Square Means and Standard Deviations (in parenthesis) for the MBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	78.03 (20.56)	82.99 (22.72)	88.4 (24.33)	91.43 (24.38)	71.32 (10.03)	73.59 (10.79)	76.19 (11.47)	77.74 (11.54)
		Th2	76.18 (19.91)	82.44 (22.72)	87.41 (24.57)	90.2 (24.04)	70.37 (9.62)	73.3 (10.77)	75.67 (11.56)	77.1 (11.32)
	CS=50	Th1	56.65 (19.69)	46.44 (17.26)	38.4 (14.93)	34.55 (14.1)	61.45 (7.89)	58.06 (6.34)	55.7 (5.23)	54.59 (4.84)
		Th2	55.46 (18.44)	43.36 (16.62)	34.11 (13.83)	32.11 (13.08)	60.97 (7.42)	57.12 (5.99)	54.46 (4.78)	53.89 (4.48)
	CS=100	Th1	29.78 (12.53)	21.54 (10.15)	16.45 (8.14)	14.13 (7.37)	53.77 (4.2)	51.87 (3.33)	50.51 (2.77)	49.7 (2.53)
		Th2	29.89 (12.55)	19.9 (9.41)	14.2 (7.42)	13.04 (6.83)	53.82 (4.2)	51.51 (3.11)	49.92 (2.53)	49.42 (2.39)
NC=50										
	CS=10	Th1	95.62 (27.78)	103.3 (31.09)	110.26 (33.89)	114.4 (35.19)	81.71 (14.9)	85.38 (16.05)	88.79 (17.13)	91.05 (17.75)
		Th2	92.28 (26.09)	102.76 (31.7)	111.12 (35.19)	114.54 (35.21)	79.78 (13.85)	84.93 (16.25)	89.08 (17.68)	91.01 (17.63)
	CS=50	Th1	86.4 (30.6)	74.66 (28.04)	64.75 (25.14)	60.45 (24.05)	74.66 (13.81)	68.83 (11.52)	64.76 (9.74)	63.15 (9.1)
		Th2	83.26 (28.72)	70.33 (26.63)	58.19 (23.3)	56.32 (22.66)	73.28 (13.04)	66.99 (10.79)	62.3 (8.8)	61.67 (8.45)
	CS=100	Th1	52.18 (20.5)	39.07 (16.44)	30.97 (14.2)	27.7 (13.01)	60.34 (7.21)	56.43 (5.46)	54.17 (4.62)	53.2 (4.23)
		Th2	51.21 (20.07)	36.4 (15.86)	26.97 (12.54)	25.58 (12.07)	60.01 (7.06)	55.7 (5.2)	53.03 (4.09)	52.6 (3.95)
NC=100										
	CS=10	Th1	137.93 (40.75)	152.21 (46.5)	164.17 (51.12)	169.98 (53.25)	109.19 (23.49)	115.87 (25.57)	121.53 (27.16)	124.53 (28.01)
		Th2	131.07 (39.96)	152.34 (47.52)	167.76 (53.47)	172.13 (54.08)	104.99 (22.97)	115.58 (25.92)	123.02 (28.06)	125.46 (28.26)
	CS=50	Th1	157.51 (51.54)	146.77 (49.75)	134.34 (46.46)	128.19 (45.03)	115.27 (26.63)	105.77 (23.84)	97.31 (21.22)	93.59 (20.1)
		Th2	151.26 (50.02)	139.77 (48.35)	124.46 (43.78)	122.57 (43.59)	111.9 (25.93)	101.38 (22.71)	91.73 (19.37)	90.46 (19.09)
	CS=100	Th1	114.14 (38.3)	92.27 (32.88)	76.34 (28.61)	69.64 (26.69)	85.02 (15.42)	75.06 (12.11)	68.91 (10.01)	66.55 (9.22)
		Th2	111.38 (37.68)	85.55 (31.11)	66.88 (26.28)	64.4 (25.43)	83.9 (15.14)	72.38 (11.24)	65.61 (9.03)	64.77 (8.68)
Low-ICC										
NC=30										
	CS=10	Th1	60.94 (15.5)	67.15 (16.76)	72.97 (18.26)	77.58 (19.1)	63.15 (7.49)	66.08 (8.14)	68.91 (8.86)	71.22 (9.33)
		Th2	56.75 (15.67)	66.77 (17.4)	73.34 (18.94)	77.39 (19.06)	61.27 (7.37)	65.91 (8.41)	69.1 (9.12)	71.15 (9.26)
	CS=50	Th1	77.33 (22.53)	77.91 (22.71)	78.88 (21.9)	78.69 (21.82)	70.82 (10.69)	70.87 (10.4)	71.2 (9.86)	71.11 (9.77)
		Th2	75.75 (21.19)	77.22 (22.78)	77.35 (22.36)	77.94 (21.73)	70.09 (10.09)	70.53 (10.43)	70.44 (9.96)	70.71 (9.64)

Table B-20 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	70.51 (22.05)	64.69 (20.87)	60.12 (20.12)	57.06 (18.77)	67.07 (9.32)	64.59 (8.27)	62.93 (7.62)	61.87 (7.01)
		Th2	70.79 (22.28)	64.07 (21.01)	57.94 (19.11)	55.63 (18.15)	67.25 (9.54)	64.37 (8.24)	62.16 (7.1)	61.43 (6.73)
NC=50										
	CS=10	Th1	72.18 (18.53)	78.3 (21.47)	83.35 (23.52)	87.92 (25.06)	69.07 (10.47)	72.28 (11.75)	74.91 (12.58)	77.43 (13.33)
		Th2	68.45 (17.06)	78.32 (21.33)	84.33 (24.15)	88.01 (25.05)	67.03 (9.55)	72.27 (11.58)	75.42 (12.84)	77.46 (13.28)
	CS=50	Th1	97.66 (31.07)	101.44 (32.9)	104.12 (34.16)	106.36 (33.83)	82.45 (16.21)	83.88 (16.58)	84.89 (16.77)	85.95 (16.52)
		Th2	94.97 (29.26)	100.69 (32.61)	103.38 (33.58)	105.53 (33.59)	81.09 (15.4)	83.45 (16.37)	84.35 (16.45)	85.41 (16.39)
	CS=100	Th1	97.69 (32.75)	93.72 (32.09)	90.54 (31.44)	88.72 (30.36)	80.63 (15.28)	77.69 (14.05)	75.63 (13.05)	74.68 (12.44)
		Th2	96.78 (32.39)	92.94 (32.11)	88.54 (30.88)	87.99 (30.43)	80.39 (15.38)	77.23 (13.97)	74.64 (12.69)	74.28 (12.35)
NC=100										
	CS=10	Th1	89.08 (25.2)	97.28 (30.18)	104.38 (34.02)	108.48 (35.49)	80.58 (15.97)	84.88 (18.23)	88.55 (19.82)	90.82 (20.45)
		Th2	84.4 (22.18)	97.19 (30.51)	105.98 (35.03)	109.55 (36.47)	77.65 (14.3)	84.79 (18.43)	89.32 (20.21)	91.31 (20.84)
	CS=50	Th1	147.31 (49.42)	155.66 (50.39)	163 (53.23)	166.83 (53.3)	113.54 (27.75)	116.76 (27.38)	119.89 (28.13)	121.9 (27.97)
		Th2	139.79 (44.94)	155.39 (50.53)	163.72 (53.08)	167.49 (53.84)	109.5 (25.63)	116.46 (27.32)	119.97 (27.88)	121.95 (28.13)
	CS=100	Th1	161.54 (51.95)	163.65 (53.36)	163.14 (53.33)	165.54 (52.26)	118.5 (26.76)	116.56 (25.87)	113.94 (24.78)	114.13 (24.02)
		Th2	157.6 (51.19)	162 (52.62)	160.98 (52.36)	164.53 (52.13)	116.91 (26.74)	115.34 (25.47)	112.05 (24.09)	113.13 (23.85)

Note. MBs = Simple misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-21

CFI Means and Standard Deviations (in parenthesis) for the MBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.965 (0.039)	0.971 (0.029)	0.975 (0.023)	0.977 (0.019)	0.956 (0.049)	0.964 (0.036)	0.969 (0.029)	0.972 (0.025)
		Th2	0.964 (0.041)	0.973 (0.028)	0.979 (0.02)	0.98 (0.018)	0.955 (0.052)	0.966 (0.035)	0.973 (0.025)	0.974 (0.023)
	CS=50	Th1	0.996 (0.009)	0.999 (0.004)	1 (0.002)	1 (0.001)	0.995 (0.01)	0.999 (0.004)	1 (0.002)	1 (0.001)
		Th2	0.996 (0.009)	0.999 (0.004)	1 (0.001)	1 (0.001)	0.996 (0.01)	0.999 (0.004)	1 (0.001)	1 (0.001)
	CS=100	Th1	1 (0.001)	1 (0.001)	1 (0)	1 (0)	1 (0.001)	1 (0.001)	1 (0)	1 (0)
		Th2	1 (0.001)	1 (0)	1 (0)	1 (0)	1 (0.001)	1 (0)	1 (0)	1 (0)
NC=50										
	CS=10	Th1	0.958 (0.035)	0.966 (0.026)	0.971 (0.021)	0.974 (0.018)	0.947 (0.044)	0.957 (0.034)	0.964 (0.027)	0.966 (0.024)
		Th2	0.957 (0.036)	0.968 (0.026)	0.974 (0.019)	0.975 (0.017)	0.946 (0.047)	0.959 (0.033)	0.967 (0.025)	0.969 (0.023)
	CS=50	Th1	0.989 (0.012)	0.995 (0.007)	0.998 (0.004)	0.998 (0.003)	0.988 (0.014)	0.994 (0.008)	0.997 (0.005)	0.998 (0.004)
		Th2	0.989 (0.012)	0.996 (0.006)	0.998 (0.003)	0.999 (0.003)	0.988 (0.014)	0.995 (0.007)	0.998 (0.004)	0.999 (0.003)
	CS=100	Th1	0.998 (0.004)	1 (0.001)	1 (0.001)	1 (0.001)	0.998 (0.004)	1 (0.001)	1 (0.001)	1 (0.001)
		Th2	0.999 (0.004)	1 (0.001)	1 (0)	1 (0)	0.998 (0.004)	1 (0.001)	1 (0)	1 (0)
NC=100										
	CS=10	Th1	0.951 (0.026)	0.961 (0.02)	0.968 (0.016)	0.97 (0.015)	0.938 (0.034)	0.951 (0.026)	0.959 (0.022)	0.962 (0.02)
		Th2	0.95 (0.029)	0.963 (0.02)	0.97 (0.015)	0.972 (0.014)	0.937 (0.038)	0.953 (0.026)	0.962 (0.02)	0.964 (0.019)
	CS=50	Th1	0.983 (0.009)	0.99 (0.006)	0.993 (0.005)	0.994 (0.004)	0.979 (0.012)	0.988 (0.008)	0.992 (0.005)	0.994 (0.005)
		Th2	0.982 (0.01)	0.991 (0.006)	0.995 (0.004)	0.995 (0.004)	0.978 (0.013)	0.989 (0.007)	0.994 (0.005)	0.995 (0.004)
	CS=100	Th1	0.993 (0.005)	0.997 (0.003)	0.998 (0.002)	0.999 (0.002)	0.992 (0.006)	0.997 (0.004)	0.998 (0.002)	0.999 (0.002)
		Th2	0.992 (0.006)	0.997 (0.003)	0.999 (0.002)	0.999 (0.001)	0.992 (0.007)	0.997 (0.003)	0.999 (0.002)	0.999 (0.001)
Low-ICC										
NC=30										
	CS=10	Th1	0.991 (0.018)	0.99 (0.016)	0.989 (0.013)	0.989 (0.012)	0.989 (0.023)	0.988 (0.02)	0.987 (0.017)	0.986 (0.015)
		Th2	0.992 (0.019)	0.99 (0.015)	0.99 (0.013)	0.989 (0.012)	0.99 (0.023)	0.988 (0.019)	0.988 (0.016)	0.987 (0.015)
	CS=50	Th1	0.993 (0.009)	0.995 (0.006)	0.996 (0.004)	0.997 (0.004)	0.991 (0.011)	0.994 (0.008)	0.996 (0.005)	0.996 (0.004)
		Th2	0.992 (0.01)	0.995 (0.006)	0.997 (0.004)	0.997 (0.003)	0.99 (0.013)	0.994 (0.007)	0.996 (0.005)	0.997 (0.004)

Table B-21 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.997 (0.005)	0.998 (0.003)	0.999 (0.002)	0.999 (0.002)	0.996 (0.006)	0.998 (0.003)	0.999 (0.002)	0.999 (0.002)
		Th2	0.996 (0.006)	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)	0.995 (0.007)	0.998 (0.003)	0.999 (0.002)	0.999 (0.001)
NC=50										
	CS=10	Th1	0.986 (0.018)	0.987 (0.015)	0.988 (0.013)	0.988 (0.012)	0.983 (0.023)	0.984 (0.019)	0.985 (0.016)	0.985 (0.015)
		Th2	0.987 (0.019)	0.987 (0.015)	0.989 (0.012)	0.988 (0.011)	0.984 (0.023)	0.984 (0.019)	0.986 (0.015)	0.985 (0.015)
	CS=50	Th1	0.991 (0.008)	0.993 (0.006)	0.995 (0.004)	0.995 (0.004)	0.988 (0.011)	0.992 (0.007)	0.993 (0.006)	0.994 (0.005)
		Th2	0.99 (0.009)	0.994 (0.006)	0.995 (0.004)	0.995 (0.004)	0.987 (0.012)	0.992 (0.007)	0.994 (0.005)	0.994 (0.005)
	CS=100	Th1	0.994 (0.005)	0.996 (0.003)	0.997 (0.003)	0.998 (0.002)	0.993 (0.006)	0.996 (0.004)	0.997 (0.003)	0.998 (0.002)
		Th2	0.993 (0.006)	0.996 (0.004)	0.998 (0.002)	0.998 (0.002)	0.992 (0.007)	0.996 (0.004)	0.997 (0.003)	0.998 (0.002)
NC=100										
	CS=10	Th1	0.984 (0.015)	0.986 (0.012)	0.988 (0.01)	0.988 (0.009)	0.98 (0.019)	0.982 (0.015)	0.984 (0.013)	0.985 (0.012)
		Th2	0.984 (0.015)	0.986 (0.012)	0.988 (0.01)	0.988 (0.009)	0.98 (0.019)	0.983 (0.016)	0.985 (0.013)	0.985 (0.012)
	CS=50	Th1	0.989 (0.006)	0.992 (0.004)	0.994 (0.004)	0.994 (0.003)	0.986 (0.009)	0.99 (0.006)	0.992 (0.005)	0.993 (0.004)
		Th2	0.988 (0.007)	0.992 (0.004)	0.994 (0.003)	0.994 (0.003)	0.985 (0.009)	0.99 (0.006)	0.992 (0.004)	0.993 (0.004)
	CS=100	Th1	0.993 (0.004)	0.995 (0.003)	0.996 (0.002)	0.996 (0.002)	0.991 (0.005)	0.994 (0.004)	0.995 (0.003)	0.996 (0.002)
		Th2	0.992 (0.005)	0.995 (0.003)	0.996 (0.002)	0.997 (0.002)	0.989 (0.006)	0.994 (0.004)	0.996 (0.002)	0.996 (0.002)

Note. MBs = Simple misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-22

TLI Means and Standard Deviations (in parenthesis) for the MBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.961 (0.064)	0.965 (0.045)	0.968 (0.034)	0.97 (0.028)	0.95 (0.08)	0.955 (0.057)	0.96 (0.043)	0.962 (0.036)
		Th2	0.962 (0.072)	0.967 (0.043)	0.973 (0.03)	0.973 (0.026)	0.953 (0.089)	0.958 (0.055)	0.966 (0.038)	0.966 (0.033)
	CS=50	Th1	1.01 (0.024)	1.016 (0.016)	1.019 (0.012)	1.02 (0.011)	1.01 (0.026)	1.017 (0.017)	1.02 (0.012)	1.021 (0.011)
		Th2	1.013 (0.025)	1.019 (0.016)	1.021 (0.011)	1.021 (0.01)	1.014 (0.028)	1.019 (0.016)	1.021 (0.011)	1.022 (0.011)
	CS=100	Th1	1.043 (0.019)	1.043 (0.016)	1.042 (0.015)	1.044 (0.015)	1.044 (0.019)	1.044 (0.017)	1.045 (0.016)	1.046 (0.017)
		Th2	1.048 (0.021)	1.045 (0.016)	1.043 (0.016)	1.044 (0.016)	1.049 (0.022)	1.047 (0.017)	1.046 (0.017)	1.047 (0.018)
NC=50										
	CS=10	Th1	0.943 (0.051)	0.954 (0.037)	0.961 (0.03)	0.964 (0.026)	0.929 (0.065)	0.941 (0.048)	0.95 (0.039)	0.954 (0.034)
		Th2	0.943 (0.054)	0.956 (0.037)	0.965 (0.027)	0.966 (0.024)	0.929 (0.069)	0.945 (0.048)	0.955 (0.035)	0.957 (0.032)
	CS=50	Th1	0.987 (0.018)	0.996 (0.012)	1 (0.009)	1.001 (0.008)	0.985 (0.022)	0.995 (0.014)	1 (0.009)	1.001 (0.008)
		Th2	0.988 (0.019)	0.998 (0.011)	1.002 (0.008)	1.003 (0.007)	0.986 (0.023)	0.997 (0.013)	1.002 (0.008)	1.003 (0.007)
	CS=100	Th1	1.007 (0.011)	1.011 (0.007)	1.012 (0.006)	1.013 (0.005)	1.007 (0.012)	1.011 (0.008)	1.012 (0.006)	1.013 (0.005)
		Th2	1.008 (0.012)	1.012 (0.007)	1.013 (0.005)	1.013 (0.005)	1.008 (0.013)	1.012 (0.008)	1.013 (0.005)	1.014 (0.005)
NC=100										
	CS=10	Th1	0.933 (0.036)	0.947 (0.028)	0.955 (0.023)	0.959 (0.021)	0.914 (0.047)	0.932 (0.037)	0.943 (0.03)	0.947 (0.027)
		Th2	0.931 (0.04)	0.949 (0.027)	0.959 (0.021)	0.961 (0.02)	0.913 (0.052)	0.934 (0.036)	0.947 (0.028)	0.95 (0.026)
	CS=50	Th1	0.977 (0.013)	0.986 (0.009)	0.991 (0.006)	0.992 (0.006)	0.971 (0.017)	0.983 (0.011)	0.989 (0.008)	0.991 (0.006)
		Th2	0.975 (0.014)	0.987 (0.009)	0.993 (0.006)	0.993 (0.005)	0.969 (0.019)	0.985 (0.01)	0.992 (0.006)	0.993 (0.006)
	CS=100	Th1	0.99 (0.008)	0.996 (0.005)	0.999 (0.003)	0.999 (0.003)	0.989 (0.009)	0.996 (0.005)	0.999 (0.004)	0.999 (0.003)
		Th2	0.99 (0.009)	0.997 (0.005)	1 (0.003)	1 (0.003)	0.989 (0.009)	0.997 (0.005)	1 (0.003)	1 (0.003)
Low-ICC										
NC=30										
	CS=10	Th1	1.014 (0.049)	0.997 (0.032)	0.99 (0.024)	0.987 (0.02)	1.015 (0.057)	0.995 (0.038)	0.987 (0.029)	0.984 (0.025)
		Th2	1.035 (0.064)	0.998 (0.032)	0.991 (0.022)	0.988 (0.019)	1.037 (0.071)	0.996 (0.038)	0.988 (0.027)	0.985 (0.024)
	CS=50	Th1	0.992 (0.015)	0.995 (0.01)	0.996 (0.007)	0.996 (0.006)	0.99 (0.018)	0.993 (0.012)	0.995 (0.008)	0.996 (0.007)
		Th2	0.992 (0.016)	0.995 (0.01)	0.996 (0.006)	0.997 (0.006)	0.99 (0.02)	0.994 (0.012)	0.996 (0.008)	0.996 (0.007)

Table B-22 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.998 (0.009)	1 (0.006)	1.001 (0.005)	1.002 (0.004)	0.997 (0.011)	1 (0.007)	1.001 (0.005)	1.002 (0.004)
		Th2	0.997 (0.011)	1 (0.006)	1.001 (0.004)	1.002 (0.004)	0.996 (0.013)	1 (0.007)	1.001 (0.005)	1.002 (0.004)
NC=50										
	CS=10	Th1	0.988 (0.033)	0.985 (0.024)	0.985 (0.019)	0.984 (0.017)	0.984 (0.041)	0.981 (0.031)	0.981 (0.025)	0.98 (0.022)
		Th2	0.994 (0.037)	0.985 (0.024)	0.986 (0.018)	0.985 (0.017)	0.991 (0.044)	0.981 (0.03)	0.982 (0.023)	0.981 (0.022)
	CS=50	Th1	0.988 (0.012)	0.991 (0.008)	0.993 (0.006)	0.994 (0.005)	0.984 (0.015)	0.989 (0.01)	0.991 (0.008)	0.992 (0.007)
		Th2	0.987 (0.013)	0.991 (0.008)	0.993 (0.006)	0.994 (0.005)	0.983 (0.017)	0.989 (0.01)	0.992 (0.007)	0.992 (0.006)
	CS=100	Th1	0.992 (0.008)	0.995 (0.005)	0.997 (0.004)	0.997 (0.003)	0.991 (0.009)	0.995 (0.006)	0.996 (0.005)	0.997 (0.004)
		Th2	0.991 (0.009)	0.995 (0.005)	0.997 (0.004)	0.997 (0.003)	0.989 (0.011)	0.995 (0.006)	0.997 (0.004)	0.997 (0.004)
NC=100										
	CS=10	Th1	0.979 (0.022)	0.981 (0.017)	0.983 (0.015)	0.984 (0.013)	0.973 (0.028)	0.976 (0.022)	0.978 (0.019)	0.979 (0.017)
		Th2	0.98 (0.023)	0.982 (0.017)	0.984 (0.014)	0.984 (0.013)	0.974 (0.029)	0.977 (0.022)	0.979 (0.018)	0.98 (0.017)
	CS=50	Th1	0.985 (0.009)	0.989 (0.006)	0.991 (0.005)	0.992 (0.004)	0.981 (0.012)	0.986 (0.008)	0.989 (0.006)	0.99 (0.006)
		Th2	0.984 (0.01)	0.989 (0.006)	0.992 (0.005)	0.992 (0.004)	0.979 (0.013)	0.986 (0.008)	0.989 (0.006)	0.99 (0.005)
	CS=100	Th1	0.99 (0.006)	0.993 (0.004)	0.995 (0.003)	0.995 (0.003)	0.987 (0.007)	0.991 (0.005)	0.994 (0.004)	0.994 (0.003)
		Th2	0.989 (0.007)	0.993 (0.004)	0.995 (0.003)	0.995 (0.003)	0.985 (0.009)	0.991 (0.005)	0.994 (0.003)	0.994 (0.003)

Note. MBs = Simple misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-23

RMSEA Means and Standard Deviations (in parenthesis) for the MBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.022 (0.018)	0.026 (0.019)	0.03 (0.019)	0.033 (0.019)	0.015 (0.012)	0.018 (0.013)	0.021 (0.013)	0.023 (0.013)
		Th2	0.021 (0.018)	0.025 (0.019)	0.029 (0.019)	0.032 (0.019)	0.014 (0.012)	0.018 (0.013)	0.02 (0.013)	0.022 (0.013)
	CS=50	Th1	0.003 (0.006)	0.001 (0.004)	0.001 (0.002)	0 (0.002)	0.002 (0.004)	0.001 (0.002)	0 (0.001)	0 (0.001)
		Th2	0.003 (0.006)	0.001 (0.003)	0 (0.002)	0 (0.001)	0.002 (0.004)	0.001 (0.002)	0 (0.001)	0 (0.001)
	CS=100	Th1	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		Th2	0 (0.001)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NC=50										
	CS=10	Th1	0.027 (0.015)	0.031 (0.016)	0.034 (0.016)	0.036 (0.016)	0.02 (0.011)	0.023 (0.011)	0.025 (0.011)	0.026 (0.011)
		Th2	0.025 (0.015)	0.031 (0.016)	0.034 (0.016)	0.036 (0.016)	0.019 (0.011)	0.022 (0.011)	0.025 (0.011)	0.026 (0.011)
	CS=50	Th1	0.01 (0.008)	0.007 (0.007)	0.005 (0.006)	0.004 (0.006)	0.007 (0.005)	0.004 (0.005)	0.003 (0.004)	0.002 (0.004)
		Th2	0.009 (0.007)	0.006 (0.007)	0.003 (0.005)	0.003 (0.005)	0.006 (0.005)	0.004 (0.004)	0.002 (0.003)	0.002 (0.003)
	CS=100	Th1	0.002 (0.003)	0 (0.002)	0 (0.001)	0 (0.001)	0.001 (0.002)	0 (0.001)	0 (0)	0 (0)
		Th2	0.001 (0.003)	0 (0.001)	0 (0)	0 (0)	0.001 (0.002)	0 (0.001)	0 (0)	0 (0)
NC=100										
	CS=10	Th1	0.032 (0.01)	0.035 (0.011)	0.038 (0.011)	0.039 (0.011)	0.025 (0.008)	0.027 (0.008)	0.028 (0.008)	0.029 (0.008)
		Th2	0.03 (0.011)	0.035 (0.011)	0.038 (0.011)	0.039 (0.011)	0.024 (0.008)	0.027 (0.008)	0.029 (0.008)	0.029 (0.008)
	CS=50	Th1	0.016 (0.005)	0.015 (0.005)	0.014 (0.005)	0.013 (0.006)	0.012 (0.004)	0.011 (0.004)	0.009 (0.004)	0.009 (0.004)
		Th2	0.015 (0.005)	0.014 (0.005)	0.012 (0.006)	0.012 (0.006)	0.011 (0.004)	0.01 (0.004)	0.008 (0.004)	0.008 (0.004)
	CS=100	Th1	0.008 (0.004)	0.006 (0.004)	0.004 (0.004)	0.003 (0.003)	0.005 (0.002)	0.003 (0.002)	0.002 (0.002)	0.002 (0.002)
		Th2	0.008 (0.004)	0.005 (0.004)	0.003 (0.003)	0.002 (0.003)	0.005 (0.002)	0.003 (0.002)	0.002 (0.002)	0.001 (0.002)
Low-ICC										
NC=30										
	CS=10	Th1	0.008 (0.013)	0.013 (0.015)	0.018 (0.017)	0.022 (0.017)	0.006 (0.009)	0.009 (0.011)	0.013 (0.012)	0.015 (0.012)
		Th2	0.006 (0.011)	0.013 (0.015)	0.018 (0.017)	0.022 (0.017)	0.004 (0.008)	0.009 (0.011)	0.013 (0.012)	0.015 (0.012)
	CS=50	Th1	0.01 (0.008)	0.01 (0.009)	0.01 (0.008)	0.01 (0.008)	0.007 (0.006)	0.007 (0.006)	0.007 (0.006)	0.007 (0.006)
		Th2	0.009 (0.008)	0.009 (0.008)	0.01 (0.008)	0.01 (0.008)	0.006 (0.006)	0.006 (0.006)	0.006 (0.006)	0.007 (0.005)

Table B-23 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.005 (0.006)	0.004 (0.005)	0.003 (0.005)	0.002 (0.004)	0.003 (0.004)	0.002 (0.003)	0.002 (0.003)	0.001 (0.003)
		Th2	0.005 (0.006)	0.004 (0.005)	0.003 (0.004)	0.002 (0.004)	0.003 (0.004)	0.002 (0.003)	0.002 (0.003)	0.001 (0.002)
NC=50										
	CS=10	Th1	0.013 (0.013)	0.017 (0.014)	0.02 (0.015)	0.023 (0.015)	0.01 (0.01)	0.013 (0.011)	0.015 (0.011)	0.017 (0.011)
		Th2	0.011 (0.012)	0.017 (0.014)	0.021 (0.015)	0.023 (0.015)	0.008 (0.009)	0.013 (0.01)	0.015 (0.011)	0.017 (0.011)
	CS=50	Th1	0.012 (0.007)	0.013 (0.007)	0.014 (0.007)	0.014 (0.007)	0.009 (0.005)	0.01 (0.005)	0.01 (0.005)	0.01 (0.005)
		Th2	0.012 (0.007)	0.013 (0.007)	0.014 (0.007)	0.014 (0.007)	0.009 (0.005)	0.009 (0.005)	0.01 (0.005)	0.01 (0.005)
	CS=100	Th1	0.009 (0.005)	0.008 (0.005)	0.008 (0.005)	0.007 (0.005)	0.006 (0.004)	0.005 (0.004)	0.005 (0.003)	0.005 (0.003)
		Th2	0.009 (0.005)	0.008 (0.005)	0.007 (0.005)	0.007 (0.005)	0.006 (0.004)	0.005 (0.004)	0.005 (0.003)	0.005 (0.003)
NC=100										
	CS=10	Th1	0.017 (0.01)	0.02 (0.011)	0.022 (0.012)	0.023 (0.012)	0.014 (0.008)	0.015 (0.009)	0.017 (0.009)	0.018 (0.009)
		Th2	0.015 (0.01)	0.02 (0.011)	0.022 (0.012)	0.024 (0.012)	0.012 (0.008)	0.015 (0.009)	0.017 (0.009)	0.018 (0.009)
	CS=50	Th1	0.015 (0.005)	0.016 (0.005)	0.017 (0.005)	0.017 (0.005)	0.012 (0.004)	0.012 (0.004)	0.012 (0.004)	0.013 (0.004)
		Th2	0.014 (0.005)	0.016 (0.005)	0.017 (0.005)	0.017 (0.005)	0.011 (0.004)	0.012 (0.004)	0.012 (0.004)	0.013 (0.004)
	CS=100	Th1	0.012 (0.004)	0.012 (0.004)	0.012 (0.004)	0.012 (0.003)	0.009 (0.003)	0.009 (0.003)	0.008 (0.003)	0.008 (0.002)
		Th2	0.011 (0.004)	0.012 (0.004)	0.012 (0.004)	0.012 (0.003)	0.009 (0.003)	0.008 (0.003)	0.008 (0.003)	0.008 (0.002)

Note. MBs = Simple misspecified between-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-24

SRMR-Between Means and Standard Deviations (in parenthesis) for the MBs by ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	High ICC				Low ICC			
			2-cat	3-cat	5-cat	7-cat	2-cat	3-cat	5-cat	7-cat
NC=30										
	CS=10	Th1	0.201 (0.045)	0.192 (0.044)	0.188 (0.045)	0.186 (0.045)	0.367 (0.082)	0.324 (0.076)	0.296 (0.071)	0.289 (0.071)
		Th2	0.209 (0.045)	0.193 (0.044)	0.186 (0.045)	0.186 (0.045)	0.396 (0.086)	0.327 (0.082)	0.294 (0.074)	0.288 (0.073)
	CS=50	Th1	0.173 (0.044)	0.172 (0.044)	0.172 (0.044)	0.171 (0.044)	0.192 (0.045)	0.186 (0.045)	0.183 (0.043)	0.182 (0.045)
		Th2	0.175 (0.044)	0.172 (0.044)	0.171 (0.044)	0.171 (0.044)	0.196 (0.044)	0.186 (0.044)	0.183 (0.044)	0.182 (0.044)
	CS=100	Th1	0.171 (0.043)	0.17 (0.043)	0.171 (0.043)	0.171 (0.043)	0.179 (0.044)	0.177 (0.044)	0.176 (0.045)	0.176 (0.045)
		Th2	0.171 (0.043)	0.171 (0.043)	0.171 (0.043)	0.171 (0.043)	0.181 (0.044)	0.177 (0.045)	0.176 (0.045)	0.176 (0.044)
NC=50										
	CS=10	Th1	0.175 (0.039)	0.17 (0.039)	0.167 (0.039)	0.166 (0.039)	0.281 (0.065)	0.244 (0.054)	0.228 (0.053)	0.222 (0.051)
		Th2	0.179 (0.039)	0.169 (0.039)	0.165 (0.039)	0.165 (0.039)	0.309 (0.071)	0.247 (0.057)	0.225 (0.053)	0.221 (0.052)
	CS=50	Th1	0.157 (0.039)	0.156 (0.039)	0.155 (0.039)	0.155 (0.039)	0.167 (0.04)	0.164 (0.04)	0.162 (0.04)	0.162 (0.04)
		Th2	0.158 (0.039)	0.156 (0.039)	0.155 (0.039)	0.155 (0.039)	0.17 (0.04)	0.164 (0.04)	0.162 (0.039)	0.162 (0.039)
	CS=100	Th1	0.157 (0.037)	0.156 (0.037)	0.157 (0.037)	0.157 (0.037)	0.161 (0.039)	0.16 (0.039)	0.159 (0.039)	0.159 (0.039)
		Th2	0.157 (0.038)	0.157 (0.037)	0.157 (0.037)	0.157 (0.037)	0.162 (0.039)	0.16 (0.039)	0.159 (0.039)	0.159 (0.039)
NC=100										
	CS=10	Th1	0.156 (0.032)	0.153 (0.031)	0.151 (0.031)	0.151 (0.031)	0.207 (0.044)	0.187 (0.04)	0.178 (0.04)	0.175 (0.039)
		Th2	0.157 (0.032)	0.153 (0.032)	0.15 (0.031)	0.15 (0.031)	0.219 (0.046)	0.188 (0.04)	0.177 (0.039)	0.175 (0.039)
	CS=50	Th1	0.146 (0.031)	0.146 (0.031)	0.145 (0.031)	0.145 (0.031)	0.151 (0.033)	0.149 (0.032)	0.148 (0.032)	0.148 (0.032)
		Th2	0.147 (0.031)	0.145 (0.031)	0.145 (0.031)	0.145 (0.031)	0.152 (0.033)	0.149 (0.032)	0.148 (0.032)	0.148 (0.032)
	CS=100	Th1	0.147 (0.029)	0.147 (0.029)	0.147 (0.029)	0.147 (0.029)	0.149 (0.031)	0.148 (0.031)	0.147 (0.031)	0.149 (0.03)
		Th2	0.147 (0.029)	0.147 (0.029)	0.147 (0.029)	0.147 (0.029)	0.149 (0.031)	0.148 (0.031)	0.147 (0.031)	0.149 (0.03)

Note. MBs = Simple misspecified between-level model. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-25

Chi-Square Means and Standard Deviations (in parenthesis) for the MWs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	119.92 (36.97)	165.88 (55.81)	228.75 (79.03)	275.08 (95.82)	93.4 (19.07)	116.63 (28.35)	148.61 (40.08)	172.4 (48.72)
		Th2	112.62 (36.19)	171.16 (56.91)	251.22 (84.8)	286 (97.25)	89.24 (18.4)	119.04 (28.8)	159.63 (42.9)	177.62 (49.43)
	CS=50	Th1	187.46 (53.39)	227.53 (67.74)	259.19 (85.53)	268.86 (93.54)	114.38 (23.87)	124.08 (27.79)	131.62 (32.67)	133.51 (34.49)
		Th2	166.23 (50.85)	224.26 (71.42)	264.66 (86.55)	273.28 (95.13)	106.17 (22.47)	121.81 (28.83)	131.95 (32.45)	134.39 (35.25)
	CS=100	Th1	141.49 (51.73)	162.08 (61.62)	174.95 (74.52)	180.27 (79.24)	89.06 (17.59)	94 (19.31)	97.56 (22.91)	99.41 (24.44)
		Th2	125.76 (43.48)	159.1 (59.56)	180.3 (76.65)	181.15 (83.9)	84.1 (14.61)	92.97 (18.61)	99.07 (23.67)	99.73 (26.04)
NC=50										
	CS=10	Th1	162.04 (46.22)	233.93 (66.44)	322.1 (92.18)	381.53 (107.07)	122.89 (27.41)	164.07 (38.6)	214.14 (52.82)	248.63 (61.38)
		Th2	146.2 (43.5)	241.99 (71.48)	360.38 (104.45)	404.93 (114.7)	112.84 (25.55)	167.97 (41.05)	235.1 (59.18)	261.14 (65.17)
	CS=50	Th1	360.46 (80.48)	466.58 (109.02)	552.77 (133.65)	592.09 (150.53)	205.15 (43.48)	233.55 (54.38)	253.61 (60.51)	262.73 (65.58)
		Th2	314.33 (74.63)	462.75 (108.48)	576.94 (138.6)	605.3 (150.12)	183.99 (40.48)	227.78 (52.12)	257.64 (61.24)	264.76 (64.5)
	CS=100	Th1	317.32 (79.42)	380.01 (109.83)	428.85 (134.15)	449.39 (152.07)	151.35 (31.55)	165.71 (39.58)	178.13 (45.57)	184.25 (51.03)
		Th2	280.65 (76.25)	373.28 (118.93)	447.94 (146.11)	461.63 (159.94)	139.08 (29.95)	162.67 (42.06)	183.21 (49)	187.38 (52.72)
NC=100										
	CS=10	Th1	259.29 (60.53)	399.61 (88.81)	555.96 (117.57)	650.04 (134.49)	198.39 (41.31)	288.25 (58.52)	385.26 (75.35)	443.81 (85.2)
		Th2	228.62 (56.69)	415.16 (94.83)	632.81 (134.89)	697.75 (146.44)	176.52 (38.42)	296.59 (61.68)	430.94 (84.39)	471.59 (91.26)
	CS=50	Th1	857.82 (130.8)	1204.7 (187.75)	1501.6 (245.77)	1638.7 (269.56)	530.92 (87.65)	655.48 (120.62)	743.81 (146.69)	779.23 (153.76)
		Th2	737.18 (123.36)	1206.7 (192.06)	1603.3 (264.24)	1689.2 (283.8)	461.26 (81.09)	639.12 (117.76)	761.11 (149.39)	782.52 (156.85)
	CS=100	Th1	931.91 (178.64)	1188.5 (246.16)	1378.8 (320.44)	1475.3 (366.4)	412.54 (89.76)	471.21 (106.86)	514.22 (125.68)	539.73 (140.08)
		Th2	822.05 (158.26)	1177.3 (255.32)	1457.1 (354.53)	1505.0 (381.16)	370.97 (77.52)	459.3 (107.69)	532.15 (136.09)	544.05 (142.86)
Low-ICC										
NC=30										
	CS=10	Th1	134.21 (42.28)	193.02 (62.87)	265.52 (89.34)	321.08 (108.74)	100.09 (21.86)	129.64 (31.91)	166.6 (45.25)	195.37 (55.34)
		Th2	114.1 (40.1)	192.2 (61.7)	282.11 (91.22)	330.53 (107.67)	89.55 (20.2)	129.11 (31.47)	174.74 (46.34)	199.93 (55.09)
	CS=50	Th1	480.69 (108.22)	740.26 (160.58)	1030.3 (207.15)	1221.2 (262.96)	276.81 (54.69)	396.96 (79.21)	523.14 (102.91)	606.78 (130.07)
		Th2	394.62 (92.04)	729.05 (157.21)	1076.5 (224.33)	1249.2 (265.67)	233.11 (46.71)	389.63 (77.84)	539.76 (109.78)	614.4 (131.04)

Table B-25 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	750.47 (137.41)	1048.9 (200.28)	1317.7 (266.8)	1456.3 (313.18)	366.67 (70.34)	460.28 (98.31)	537.96 (122.92)	577.94 (141.37)
		Th2	626.58 (126.37)	1021.8 (202.7)	1348.9 (283.63)	1495.6 (329.57)	316.02 (62.97)	445.21 (98.92)	540.23 (130.2)	586.71 (145.11)
NC=50										
	CS=10	Th1	188.04 (51.26)	273.24 (73.69)	369.97 (102.88)	435.87 (118.64)	138.55 (30.55)	187.4 (42.84)	241.99 (59.29)	280.22 (67.68)
		Th2	159.01 (48.49)	271.28 (74.13)	395.01 (107.2)	452.22 (121.26)	120.42 (28.99)	185.57 (43.04)	255.79 (61.37)	289.02 (69.33)
	CS=50	Th1	775.8 (135.68)	1201.8 (199.49)	1642.4 (263.28)	1917.3 (305.8)	484.33 (78.64)	712.61 (111.84)	935.74 (147.62)	1073.1 (170.6)
		Th2	626.12 (115.74)	1187.0 (198.1)	1741.8 (277.88)	1981.0 (316.97)	396.62 (67.47)	700.88 (111.12)	979.4 (155.3)	1099.6 (177.91)
	CS=100	Th1	1326.0 (184.36)	1905.8 (272.06)	2421.6 (349.2)	2700.1 (408.81)	720.18 (111.41)	930.73 (165.9)	1097.6 (205.21)	1182.8 (232.32)
		Th2	1090.6 (171.92)	1865.1 (263.24)	2510.0 (352.36)	2757.9 (404.6)	604.57 (101.87)	904.19 (158.77)	1111.8 (206.18)	1192.8 (230.73)
NC=100										
	CS=10	Th1	309.83 (68.94)	466.95 (101.44)	625.95 (136.24)	718.52 (151.69)	235.09 (47.44)	335 (66.88)	432.57 (86.94)	490.07 (95.69)
		Th2	257.07 (64.36)	461.58 (101.19)	671.81 (141.61)	747.81 (157.57)	198.2 (44.43)	330.21 (66.46)	459.62 (89.53)	506.72 (98.93)
	CS=50	Th1	1503.7 (187.88)	2366.4 (276.09)	3191.8 (360.11)	3641.0 (398.77)	1039.9 (123.24)	1570.3 (173.22)	2049.4 (221.49)	2310.4 (241.88)
		Th2	1207.1 (162.13)	2336.9 (281.25)	3402.0 (382.94)	3780.1 (418.33)	842.19 (107.5)	1542.9 (176.04)	2160.5 (232.06)	2377.6 (252.35)
	CS=100	Th1	2796.7 (272.23)	4172.1 (409.28)	5348.6 (530.84)	5939.0 (605.4)	1770.7 (187.29)	2416.5 (292.44)	2878.5 (383.32)	3088.1 (440.91)
		Th2	2268.0 (253.11)	4074.6 (387.15)	5588.1 (549.89)	6097.4 (615.18)	1460.5 (170.99)	2330.6 (283.11)	2933.3 (401.64)	3120.1 (433.06)

Note. MWs = Simple misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-26

CFI Means and Standard Deviations (in parenthesis) for the MWs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.88 (0.068)	0.861 (0.062)	0.846 (0.058)	0.837 (0.057)	0.849 (0.087)	0.822 (0.082)	0.801 (0.078)	0.79 (0.077)
		Th2	0.882 (0.075)	0.86 (0.059)	0.843 (0.054)	0.838 (0.054)	0.854 (0.094)	0.821 (0.078)	0.799 (0.074)	0.791 (0.073)
	CS=50	Th1	0.902 (0.036)	0.903 (0.033)	0.906 (0.034)	0.908 (0.036)	0.894 (0.041)	0.9 (0.035)	0.905 (0.036)	0.907 (0.038)
		Th2	0.909 (0.038)	0.906 (0.035)	0.908 (0.034)	0.908 (0.036)	0.902 (0.043)	0.903 (0.038)	0.907 (0.035)	0.907 (0.038)
	CS=100	Th1	0.938 (0.036)	0.936 (0.039)	0.936 (0.042)	0.934 (0.042)	0.938 (0.037)	0.935 (0.04)	0.934 (0.044)	0.931 (0.045)
		Th2	0.945 (0.035)	0.937 (0.038)	0.935 (0.042)	0.935 (0.044)	0.944 (0.036)	0.935 (0.039)	0.932 (0.045)	0.932 (0.047)
NC=50										
	CS=10	Th1	0.872 (0.051)	0.855 (0.045)	0.843 (0.043)	0.837 (0.041)	0.83 (0.069)	0.805 (0.064)	0.787 (0.062)	0.778 (0.061)
		Th2	0.879 (0.053)	0.854 (0.045)	0.84 (0.042)	0.836 (0.04)	0.842 (0.071)	0.804 (0.064)	0.784 (0.061)	0.778 (0.06)
	CS=50	Th1	0.876 (0.028)	0.879 (0.027)	0.883 (0.027)	0.886 (0.028)	0.858 (0.036)	0.871 (0.032)	0.88 (0.03)	0.884 (0.031)
		Th2	0.883 (0.028)	0.881 (0.028)	0.886 (0.027)	0.887 (0.027)	0.865 (0.036)	0.875 (0.032)	0.884 (0.029)	0.886 (0.03)
	CS=100	Th1	0.904 (0.027)	0.906 (0.029)	0.908 (0.032)	0.908 (0.035)	0.904 (0.028)	0.907 (0.03)	0.908 (0.033)	0.907 (0.036)
		Th2	0.908 (0.029)	0.908 (0.033)	0.909 (0.034)	0.908 (0.036)	0.908 (0.03)	0.908 (0.034)	0.907 (0.035)	0.906 (0.038)
NC=100										
	CS=10	Th1	0.871 (0.033)	0.853 (0.031)	0.842 (0.029)	0.836 (0.028)	0.818 (0.049)	0.79 (0.047)	0.773 (0.045)	0.764 (0.046)
		Th2	0.877 (0.035)	0.853 (0.031)	0.838 (0.029)	0.835 (0.029)	0.829 (0.051)	0.79 (0.048)	0.768 (0.046)	0.763 (0.046)
	CS=50	Th1	0.857 (0.02)	0.857 (0.02)	0.86 (0.021)	0.863 (0.02)	0.813 (0.032)	0.83 (0.029)	0.844 (0.028)	0.851 (0.027)
		Th2	0.862 (0.021)	0.86 (0.02)	0.863 (0.021)	0.864 (0.021)	0.819 (0.033)	0.836 (0.029)	0.851 (0.027)	0.855 (0.027)
	CS=100	Th1	0.877 (0.023)	0.882 (0.024)	0.887 (0.027)	0.888 (0.029)	0.874 (0.027)	0.884 (0.026)	0.889 (0.028)	0.89 (0.03)
		Th2	0.88 (0.023)	0.883 (0.027)	0.889 (0.028)	0.889 (0.028)	0.875 (0.027)	0.883 (0.029)	0.89 (0.029)	0.891 (0.03)
Low-ICC										
NC=30										
	CS=10	Th1	0.86 (0.072)	0.839 (0.062)	0.827 (0.059)	0.818 (0.058)	0.832 (0.09)	0.802 (0.081)	0.784 (0.079)	0.772 (0.079)
		Th2	0.881 (0.08)	0.842 (0.062)	0.827 (0.056)	0.818 (0.057)	0.858 (0.098)	0.806 (0.08)	0.784 (0.076)	0.773 (0.077)
	CS=50	Th1	0.813 (0.041)	0.803 (0.04)	0.795 (0.038)	0.791 (0.042)	0.762 (0.058)	0.754 (0.055)	0.752 (0.051)	0.751 (0.054)
		Th2	0.824 (0.041)	0.805 (0.039)	0.797 (0.039)	0.791 (0.041)	0.778 (0.057)	0.759 (0.053)	0.757 (0.05)	0.753 (0.052)

Table B-26 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.801 (0.036)	0.799 (0.037)	0.8 (0.04)	0.8 (0.041)	0.77 (0.046)	0.78 (0.044)	0.789 (0.045)	0.791 (0.045)
		Th2	0.809 (0.037)	0.802 (0.038)	0.802 (0.04)	0.799 (0.041)	0.777 (0.048)	0.785 (0.045)	0.793 (0.046)	0.791 (0.045)
NC=50										
	CS=10	Th1	0.849 (0.051)	0.835 (0.045)	0.826 (0.045)	0.821 (0.043)	0.81 (0.067)	0.788 (0.063)	0.774 (0.065)	0.767 (0.064)
		Th2	0.861 (0.058)	0.839 (0.044)	0.828 (0.042)	0.823 (0.042)	0.83 (0.074)	0.793 (0.062)	0.777 (0.061)	0.768 (0.062)
	CS=50	Th1	0.811 (0.03)	0.802 (0.03)	0.796 (0.03)	0.793 (0.03)	0.745 (0.049)	0.737 (0.048)	0.735 (0.046)	0.735 (0.046)
		Th2	0.823 (0.03)	0.804 (0.03)	0.798 (0.029)	0.794 (0.03)	0.762 (0.047)	0.741 (0.046)	0.74 (0.044)	0.738 (0.044)
	CS=100	Th1	0.797 (0.028)	0.793 (0.029)	0.794 (0.029)	0.795 (0.031)	0.747 (0.041)	0.759 (0.039)	0.773 (0.038)	0.778 (0.039)
		Th2	0.804 (0.029)	0.796 (0.028)	0.797 (0.029)	0.795 (0.03)	0.755 (0.043)	0.764 (0.039)	0.778 (0.037)	0.779 (0.037)
NC=100										
	CS=10	Th1	0.846 (0.035)	0.834 (0.032)	0.828 (0.031)	0.825 (0.031)	0.799 (0.048)	0.778 (0.047)	0.767 (0.048)	0.762 (0.048)
		Th2	0.855 (0.039)	0.838 (0.032)	0.83 (0.03)	0.826 (0.03)	0.814 (0.053)	0.783 (0.048)	0.769 (0.046)	0.763 (0.047)
	CS=50	Th1	0.813 (0.02)	0.803 (0.02)	0.799 (0.02)	0.797 (0.02)	0.729 (0.039)	0.716 (0.039)	0.715 (0.038)	0.715 (0.038)
		Th2	0.823 (0.02)	0.805 (0.02)	0.8 (0.02)	0.797 (0.02)	0.745 (0.038)	0.721 (0.038)	0.719 (0.037)	0.717 (0.037)
	CS=100	Th1	0.797 (0.02)	0.791 (0.021)	0.792 (0.021)	0.791 (0.022)	0.718 (0.038)	0.728 (0.035)	0.743 (0.034)	0.748 (0.035)
		Th2	0.805 (0.02)	0.794 (0.02)	0.794 (0.021)	0.792 (0.022)	0.728 (0.037)	0.734 (0.035)	0.75 (0.035)	0.752 (0.035)

Note. MWs = Simple misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-27

TLI Means and Standard Deviations (in parenthesis) for the MWs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.835 (0.097)	0.808 (0.086)	0.786 (0.081)	0.774 (0.079)	0.792 (0.124)	0.754 (0.113)	0.725 (0.108)	0.709 (0.106)
		Th2	0.839 (0.108)	0.806 (0.082)	0.783 (0.075)	0.775 (0.075)	0.8 (0.135)	0.752 (0.109)	0.721 (0.102)	0.711 (0.102)
	CS=50	Th1	0.864 (0.05)	0.866 (0.045)	0.87 (0.048)	0.872 (0.05)	0.853 (0.056)	0.861 (0.049)	0.868 (0.05)	0.871 (0.052)
		Th2	0.874 (0.053)	0.869 (0.049)	0.873 (0.047)	0.873 (0.05)	0.864 (0.06)	0.866 (0.052)	0.872 (0.049)	0.872 (0.052)
	CS=100	Th1	0.915 (0.051)	0.911 (0.054)	0.911 (0.059)	0.909 (0.059)	0.914 (0.052)	0.91 (0.055)	0.908 (0.061)	0.905 (0.062)
		Th2	0.924 (0.05)	0.912 (0.053)	0.91 (0.058)	0.91 (0.061)	0.923 (0.051)	0.91 (0.054)	0.906 (0.062)	0.906 (0.065)
NC=50										
	CS=10	Th1	0.822 (0.07)	0.799 (0.062)	0.783 (0.059)	0.774 (0.057)	0.765 (0.096)	0.73 (0.088)	0.706 (0.086)	0.692 (0.085)
		Th2	0.832 (0.073)	0.798 (0.062)	0.779 (0.058)	0.773 (0.056)	0.781 (0.098)	0.729 (0.089)	0.7 (0.085)	0.693 (0.083)
	CS=50	Th1	0.829 (0.039)	0.832 (0.037)	0.838 (0.037)	0.842 (0.039)	0.803 (0.05)	0.821 (0.044)	0.834 (0.041)	0.839 (0.042)
		Th2	0.837 (0.039)	0.836 (0.038)	0.842 (0.037)	0.843 (0.038)	0.813 (0.05)	0.827 (0.045)	0.84 (0.04)	0.842 (0.041)
	CS=100	Th1	0.866 (0.037)	0.87 (0.041)	0.873 (0.044)	0.873 (0.049)	0.867 (0.039)	0.871 (0.042)	0.873 (0.046)	0.872 (0.05)
		Th2	0.872 (0.04)	0.873 (0.045)	0.873 (0.047)	0.873 (0.05)	0.873 (0.042)	0.873 (0.047)	0.872 (0.049)	0.87 (0.052)
NC=100										
	CS=10	Th1	0.821 (0.046)	0.797 (0.043)	0.781 (0.04)	0.773 (0.039)	0.749 (0.067)	0.71 (0.066)	0.685 (0.063)	0.674 (0.063)
		Th2	0.83 (0.048)	0.796 (0.043)	0.776 (0.04)	0.772 (0.04)	0.763 (0.07)	0.709 (0.067)	0.678 (0.064)	0.672 (0.063)
	CS=50	Th1	0.802 (0.028)	0.803 (0.027)	0.806 (0.029)	0.81 (0.028)	0.741 (0.044)	0.765 (0.041)	0.783 (0.039)	0.794 (0.037)
		Th2	0.809 (0.029)	0.806 (0.028)	0.811 (0.029)	0.812 (0.029)	0.75 (0.045)	0.773 (0.041)	0.794 (0.037)	0.799 (0.037)
	CS=100	Th1	0.83 (0.032)	0.837 (0.034)	0.844 (0.038)	0.846 (0.04)	0.826 (0.038)	0.839 (0.036)	0.847 (0.039)	0.848 (0.041)
		Th2	0.833 (0.032)	0.838 (0.037)	0.846 (0.039)	0.847 (0.039)	0.826 (0.038)	0.838 (0.04)	0.848 (0.04)	0.849 (0.041)
Low-ICC										
NC=30										
	CS=10	Th1	0.807 (0.102)	0.777 (0.087)	0.76 (0.081)	0.748 (0.081)	0.768 (0.127)	0.726 (0.113)	0.701 (0.109)	0.684 (0.11)
		Th2	0.839 (0.117)	0.781 (0.086)	0.761 (0.078)	0.749 (0.078)	0.808 (0.142)	0.732 (0.111)	0.701 (0.105)	0.686 (0.107)
	CS=50	Th1	0.74 (0.057)	0.727 (0.055)	0.716 (0.052)	0.71 (0.058)	0.67 (0.081)	0.66 (0.077)	0.656 (0.071)	0.655 (0.075)
		Th2	0.756 (0.057)	0.73 (0.054)	0.719 (0.054)	0.711 (0.056)	0.693 (0.079)	0.666 (0.074)	0.663 (0.07)	0.658 (0.072)

Table B-27 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.725 (0.05)	0.722 (0.051)	0.723 (0.055)	0.723 (0.057)	0.682 (0.063)	0.696 (0.061)	0.707 (0.062)	0.711 (0.063)
		Th2	0.735 (0.051)	0.726 (0.052)	0.726 (0.056)	0.721 (0.057)	0.692 (0.066)	0.703 (0.062)	0.713 (0.063)	0.71 (0.063)
NC=50										
	CS=10	Th1	0.79 (0.071)	0.772 (0.063)	0.759 (0.062)	0.752 (0.06)	0.738 (0.093)	0.707 (0.088)	0.687 (0.09)	0.677 (0.088)
		Th2	0.808 (0.08)	0.777 (0.062)	0.763 (0.058)	0.754 (0.058)	0.764 (0.103)	0.714 (0.086)	0.691 (0.085)	0.679 (0.085)
	CS=50	Th1	0.738 (0.042)	0.726 (0.041)	0.718 (0.041)	0.714 (0.042)	0.646 (0.068)	0.635 (0.067)	0.633 (0.063)	0.633 (0.064)
		Th2	0.755 (0.041)	0.729 (0.041)	0.72 (0.04)	0.715 (0.041)	0.671 (0.066)	0.641 (0.064)	0.64 (0.061)	0.638 (0.062)
	CS=100	Th1	0.718 (0.038)	0.713 (0.04)	0.715 (0.04)	0.716 (0.043)	0.65 (0.057)	0.667 (0.055)	0.685 (0.053)	0.692 (0.054)
		Th2	0.729 (0.04)	0.717 (0.039)	0.718 (0.04)	0.716 (0.041)	0.661 (0.06)	0.673 (0.054)	0.693 (0.051)	0.695 (0.051)
NC=100										
	CS=10	Th1	0.786 (0.048)	0.771 (0.044)	0.762 (0.043)	0.758 (0.043)	0.721 (0.066)	0.693 (0.066)	0.677 (0.066)	0.67 (0.066)
		Th2	0.799 (0.054)	0.776 (0.045)	0.765 (0.041)	0.759 (0.041)	0.743 (0.073)	0.7 (0.066)	0.68 (0.064)	0.672 (0.065)
	CS=50	Th1	0.741 (0.028)	0.727 (0.028)	0.721 (0.028)	0.719 (0.028)	0.625 (0.054)	0.607 (0.054)	0.605 (0.053)	0.605 (0.052)
		Th2	0.755 (0.028)	0.731 (0.028)	0.723 (0.027)	0.719 (0.028)	0.647 (0.053)	0.614 (0.053)	0.611 (0.051)	0.608 (0.051)
	CS=100	Th1	0.719 (0.028)	0.711 (0.028)	0.711 (0.03)	0.711 (0.03)	0.609 (0.052)	0.623 (0.049)	0.644 (0.048)	0.652 (0.048)
		Th2	0.73 (0.028)	0.714 (0.028)	0.714 (0.03)	0.712 (0.03)	0.623 (0.052)	0.631 (0.048)	0.654 (0.048)	0.656 (0.048)

Note. MWs = Simple misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-28

RMSEA Means and Standard Deviations (in parenthesis) for the MWs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.049 (0.02)	0.069 (0.021)	0.089 (0.023)	0.101 (0.024)	0.036 (0.014)	0.049 (0.015)	0.063 (0.016)	0.072 (0.017)
		Th2	0.045 (0.02)	0.071 (0.02)	0.095 (0.022)	0.104 (0.024)	0.032 (0.014)	0.051 (0.014)	0.068 (0.016)	0.074 (0.017)
	CS=50	Th1	0.035 (0.008)	0.04 (0.009)	0.044 (0.01)	0.044 (0.011)	0.022 (0.006)	0.024 (0.006)	0.025 (0.006)	0.026 (0.007)
		Th2	0.031 (0.009)	0.039 (0.009)	0.044 (0.01)	0.045 (0.011)	0.02 (0.006)	0.023 (0.006)	0.025 (0.006)	0.026 (0.007)
	CS=100	Th1	0.019 (0.007)	0.021 (0.008)	0.022 (0.008)	0.023 (0.009)	0.01 (0.004)	0.011 (0.004)	0.012 (0.005)	0.012 (0.005)
		Th2	0.016 (0.007)	0.021 (0.007)	0.023 (0.008)	0.023 (0.009)	0.009 (0.004)	0.011 (0.004)	0.012 (0.005)	0.012 (0.005)
NC=50										
	CS=10	Th1	0.053 (0.013)	0.071 (0.014)	0.088 (0.016)	0.097 (0.016)	0.041 (0.01)	0.054 (0.011)	0.067 (0.012)	0.074 (0.012)
		Th2	0.048 (0.014)	0.072 (0.015)	0.094 (0.017)	0.101 (0.017)	0.037 (0.01)	0.055 (0.011)	0.071 (0.012)	0.077 (0.013)
	CS=50	Th1	0.042 (0.006)	0.049 (0.007)	0.054 (0.008)	0.056 (0.008)	0.029 (0.005)	0.032 (0.005)	0.034 (0.005)	0.034 (0.006)
		Th2	0.039 (0.006)	0.049 (0.007)	0.056 (0.008)	0.057 (0.008)	0.027 (0.005)	0.031 (0.005)	0.034 (0.005)	0.035 (0.006)
	CS=100	Th1	0.028 (0.004)	0.031 (0.005)	0.033 (0.006)	0.034 (0.007)	0.016 (0.003)	0.017 (0.003)	0.018 (0.004)	0.019 (0.004)
		Th2	0.025 (0.005)	0.03 (0.006)	0.034 (0.006)	0.034 (0.007)	0.015 (0.003)	0.017 (0.004)	0.019 (0.004)	0.019 (0.004)
NC=100										
	CS=10	Th1	0.054 (0.009)	0.071 (0.01)	0.086 (0.01)	0.094 (0.011)	0.045 (0.007)	0.058 (0.008)	0.07 (0.008)	0.076 (0.009)
		Th2	0.049 (0.009)	0.073 (0.01)	0.093 (0.011)	0.098 (0.011)	0.041 (0.007)	0.059 (0.008)	0.075 (0.009)	0.079 (0.009)
	CS=50	Th1	0.049 (0.004)	0.059 (0.005)	0.066 (0.006)	0.069 (0.006)	0.038 (0.004)	0.042 (0.004)	0.045 (0.005)	0.047 (0.005)
		Th2	0.045 (0.004)	0.059 (0.005)	0.069 (0.006)	0.07 (0.006)	0.035 (0.004)	0.042 (0.004)	0.046 (0.005)	0.047 (0.005)
	CS=100	Th1	0.036 (0.004)	0.041 (0.005)	0.045 (0.005)	0.046 (0.006)	0.023 (0.003)	0.025 (0.003)	0.026 (0.004)	0.027 (0.004)
		Th2	0.034 (0.004)	0.041 (0.005)	0.046 (0.006)	0.047 (0.006)	0.022 (0.003)	0.024 (0.003)	0.027 (0.004)	0.027 (0.004)
Low-ICC										
NC=30										
	CS=10	Th1	0.056 (0.02)	0.078 (0.02)	0.099 (0.023)	0.112 (0.024)	0.04 (0.015)	0.056 (0.015)	0.07 (0.016)	0.08 (0.017)
		Th2	0.045 (0.022)	0.078 (0.02)	0.103 (0.022)	0.114 (0.024)	0.032 (0.016)	0.055 (0.015)	0.073 (0.016)	0.081 (0.017)
	CS=50	Th1	0.065 (0.008)	0.083 (0.01)	0.099 (0.011)	0.108 (0.012)	0.046 (0.006)	0.058 (0.007)	0.068 (0.008)	0.074 (0.009)
		Th2	0.058 (0.008)	0.082 (0.01)	0.101 (0.011)	0.11 (0.012)	0.041 (0.006)	0.057 (0.007)	0.069 (0.008)	0.075 (0.009)

Table B-28 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.059 (0.006)	0.071 (0.007)	0.08 (0.009)	0.084 (0.009)	0.039 (0.005)	0.045 (0.006)	0.049 (0.006)	0.051 (0.007)
		Th2	0.053 (0.006)	0.07 (0.007)	0.081 (0.009)	0.085 (0.01)	0.036 (0.004)	0.044 (0.006)	0.049 (0.007)	0.051 (0.007)
NC=50										
	CS=10	Th1	0.06 (0.014)	0.079 (0.014)	0.095 (0.016)	0.105 (0.017)	0.046 (0.01)	0.06 (0.011)	0.073 (0.012)	0.08 (0.013)
		Th2	0.052 (0.014)	0.078 (0.014)	0.099 (0.016)	0.108 (0.017)	0.04 (0.011)	0.06 (0.011)	0.076 (0.012)	0.082 (0.013)
	CS=50	Th1	0.066 (0.006)	0.083 (0.007)	0.098 (0.008)	0.106 (0.009)	0.051 (0.005)	0.063 (0.005)	0.073 (0.006)	0.078 (0.007)
		Th2	0.058 (0.006)	0.083 (0.007)	0.101 (0.008)	0.108 (0.009)	0.045 (0.005)	0.062 (0.005)	0.075 (0.006)	0.079 (0.007)
	CS=100	Th1	0.062 (0.005)	0.075 (0.006)	0.085 (0.006)	0.09 (0.007)	0.045 (0.004)	0.051 (0.005)	0.056 (0.006)	0.058 (0.006)
		Th2	0.056 (0.005)	0.074 (0.005)	0.087 (0.006)	0.091 (0.007)	0.041 (0.004)	0.051 (0.005)	0.056 (0.006)	0.059 (0.006)
NC=100										
	CS=10	Th1	0.061 (0.009)	0.078 (0.01)	0.092 (0.011)	0.1 (0.012)	0.051 (0.007)	0.064 (0.008)	0.075 (0.009)	0.08 (0.009)
		Th2	0.054 (0.009)	0.077 (0.01)	0.096 (0.011)	0.102 (0.012)	0.045 (0.008)	0.063 (0.008)	0.077 (0.009)	0.082 (0.009)
	CS=50	Th1	0.066 (0.004)	0.084 (0.005)	0.098 (0.006)	0.105 (0.006)	0.055 (0.003)	0.068 (0.004)	0.078 (0.004)	0.083 (0.004)
		Th2	0.059 (0.004)	0.083 (0.005)	0.101 (0.006)	0.107 (0.006)	0.049 (0.003)	0.067 (0.004)	0.08 (0.004)	0.084 (0.005)
	CS=100	Th1	0.065 (0.003)	0.079 (0.004)	0.09 (0.005)	0.095 (0.005)	0.051 (0.003)	0.06 (0.004)	0.066 (0.004)	0.068 (0.005)
		Th2	0.058 (0.003)	0.078 (0.004)	0.092 (0.005)	0.096 (0.005)	0.046 (0.003)	0.059 (0.004)	0.066 (0.005)	0.068 (0.005)

Note. MWs = Simple misspecified within-level model. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-29

SRMR-Within Means and Standard Deviations (in parenthesis) for the MBs by ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	High ICC 2-cat	High ICC 3-cat	High ICC 5-cat	High ICC 7-cat	Low ICC 2-cat	Low ICC 3-cat	Low ICC 5-cat	Low ICC 7-cat
NC=30										
	CS=10	Th1	0.119 (0.019)	0.107 (0.018)	0.102 (0.017)	0.101 (0.016)	0.114 (0.017)	0.106 (0.016)	0.102 (0.016)	0.101 (0.016)
		Th2	0.124 (0.019)	0.106 (0.017)	0.101 (0.016)	0.1 (0.016)	0.119 (0.018)	0.106 (0.016)	0.101 (0.015)	0.1 (0.015)
	CS=50	Th1	0.097 (0.01)	0.095 (0.008)	0.094 (0.008)	0.094 (0.008)	0.096 (0.009)	0.094 (0.008)	0.094 (0.007)	0.093 (0.007)
		Th2	0.098 (0.01)	0.095 (0.008)	0.094 (0.008)	0.093 (0.008)	0.096 (0.01)	0.094 (0.008)	0.093 (0.007)	0.093 (0.007)
	CS=100	Th1	0.095 (0.007)	0.094 (0.006)	0.094 (0.006)	0.094 (0.006)	0.094 (0.006)	0.093 (0.006)	0.093 (0.005)	0.093 (0.005)
		Th2	0.096 (0.007)	0.094 (0.006)	0.094 (0.005)	0.094 (0.005)	0.094 (0.007)	0.093 (0.006)	0.093 (0.005)	0.093 (0.005)
NC=50										
	CS=10	Th1	0.109 (0.016)	0.101 (0.014)	0.098 (0.013)	0.097 (0.013)	0.105 (0.015)	0.100 (0.013)	0.098 (0.013)	0.097 (0.012)
		Th2	0.111 (0.016)	0.101 (0.014)	0.097 (0.013)	0.096 (0.013)	0.108 (0.016)	0.100 (0.013)	0.097 (0.013)	0.097 (0.012)
	CS=50	Th1	0.095 (0.008)	0.093 (0.007)	0.093 (0.006)	0.093 (0.006)	0.094 (0.007)	0.093 (0.006)	0.093 (0.006)	0.093 (0.006)
		Th2	0.095 (0.008)	0.093 (0.007)	0.093 (0.006)	0.093 (0.006)	0.094 (0.007)	0.093 (0.006)	0.093 (0.006)	0.093 (0.006)
	CS=100	Th1	0.094 (0.006)	0.093 (0.005)	0.093 (0.004)	0.093 (0.004)	0.093 (0.005)	0.093 (0.004)	0.093 (0.004)	0.093 (0.004)
		Th2	0.094 (0.006)	0.093 (0.005)	0.093 (0.004)	0.093 (0.004)	0.093 (0.006)	0.093 (0.004)	0.093 (0.004)	0.093 (0.004)
NC=100										
	CS=10	Th1	0.1 (0.012)	0.096 (0.01)	0.095 (0.009)	0.094 (0.009)	0.098 (0.011)	0.095 (0.01)	0.094 (0.01)	0.094 (0.009)
		Th2	0.102 (0.012)	0.096 (0.01)	0.094 (0.009)	0.094 (0.009)	0.100 (0.012)	0.095 (0.01)	0.094 (0.009)	0.093 (0.009)
	CS=50	Th1	0.093 (0.006)	0.092 (0.005)	0.092 (0.004)	0.092 (0.004)	0.093 (0.005)	0.092 (0.004)	0.092 (0.004)	0.092 (0.004)
		Th2	0.093 (0.006)	0.092 (0.005)	0.092 (0.004)	0.092 (0.004)	0.093 (0.005)	0.092 (0.004)	0.092 (0.004)	0.092 (0.004)
	CS=100	Th1	0.093 (0.004)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)
		Th2	0.093 (0.004)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)	0.092 (0.004)	0.092 (0.003)	0.092 (0.003)	0.092 (0.003)

Note. MWs = Simple misspecified within-level model. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-30

Chi-Square Means and Standard Deviations (in parenthesis) for the MWBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	127.14 (34.31)	168.37 (48.56)	222.37 (66.14)	261.86 (79.78)	96.45 (16.94)	116.26 (23.47)	142.62 (32.01)	162.37 (38.79)
		Th2	118.92 (32.81)	172.47 (50.28)	241.09 (71.84)	271.25 (81.49)	92.08 (16.04)	118.02 (24.21)	151.47 (34.63)	166.75 (39.7)
	CS=50	Th1	192.88 (48.49)	228.07 (61.39)	257.39 (78.27)	266.27 (85.91)	118.43 (21.82)	127 (25.87)	133.94 (30.9)	135.54 (32.87)
		Th2	172.83 (46.82)	224.77 (64.83)	262.13 (79.61)	270.42 (87.76)	110.32 (20.76)	124.53 (26.86)	133.92 (30.86)	136.19 (33.54)
	CS=100	Th1	148.41 (48.36)	166.51 (58.88)	177.17 (70.99)	181.88 (76.46)	92.75 (17)	96.79 (19.04)	99.52 (22.25)	101.11 (23.95)
		Th2	133.6 (41.13)	162.82 (56.49)	181.95 (73.63)	182.55 (80.54)	87.85 (14.27)	95.4 (18.05)	100.8 (23.12)	101.32 (25.34)
NC=50										
	CS=10	Th1	176.1 (43.99)	239.89 (59.05)	315.7 (78.76)	366.68 (90.56)	127.36 (23.86)	160.79 (31.27)	200.64 (41.66)	228.44 (48.11)
		Th2	160.36 (41.43)	245.93 (63.33)	347.39 (88.2)	385.36 (95.64)	118.23 (22.3)	163.34 (33.02)	216.76 (46.01)	237.9 (50.38)
	CS=50	Th1	357.94 (73.16)	451.51 (96.22)	530.07 (118.72)	567.35 (134.34)	205.51 (37.94)	232.99 (48.21)	252.56 (55.42)	261.74 (60.79)
		Th2	316.34 (67.7)	447.77 (96.46)	553.13 (124.49)	579.81 (135.23)	185.96 (35.38)	227.36 (46.92)	256.23 (56.95)	263.32 (60.38)
	CS=100	Th1	320.85 (72.55)	377.83 (101.33)	423.32 (125.91)	443.11 (143.36)	157.07 (29.77)	169.38 (37.73)	180.35 (44.1)	185.97 (49.22)
		Th2	286.36 (70.19)	370.7 (110.53)	441.08 (137.21)	454.34 (150.24)	144.77 (28.32)	165.79 (40.31)	184.6 (47.09)	188.53 (50.67)
NC=100										
	CS=10	Th1	293.91 (60.51)	417.21 (81.37)	549.73 (102.91)	628.46 (115.23)	206.54 (35.7)	274.97 (46.37)	347.49 (57.42)	391.46 (63.86)
		Th2	263.09 (58.68)	429.57 (86.68)	613.72 (115.92)	667.93 (124.17)	187.38 (34.29)	280.77 (48.44)	381.53 (63.24)	412.42 (67.88)
	CS=50	Th1	821.74 (116.48)	1117.71 (160.94)	1378.18 (209.3)	1502.62 (231)	488.71 (69.68)	607.73 (97.18)	696.92 (123.41)	734.95 (132.43)
		Th2	717.14 (111.07)	1120.07 (164.03)	1472.9 (226.94)	1551.11 (243.74)	430.47 (65.08)	595.8 (96.32)	718.7 (129.2)	741.42 (136.65)
	CS=100	Th1	899.15 (156.92)	1133.59 (219.55)	1313.88 (290.72)	1407.77 (334.59)	415.48 (80.44)	471 (99.43)	511.64 (119.34)	536.08 (133.49)
		Th2	797.63 (140.22)	1121.88 (229.35)	1390.37 (325.09)	1436.57 (349.26)	372.9 (69.63)	456.67 (100.88)	527.5 (130.33)	538.73 (136.32)
Low-ICC										
NC=30										
	CS=10	Th1	129.08 (36.62)	180.45 (53.42)	243.52 (75.07)	290.33 (89.97)	97.38 (18.49)	122.3 (26.25)	153.16 (36.53)	176.82 (44.14)
		Th2	110.88 (35.46)	178.94 (52.59)	256.45 (76.71)	298.07 (90.06)	88.05 (17.5)	121.45 (26.02)	159.39 (37.58)	180.57 (44.33)
	CS=50	Th1	433.24 (89.87)	653.38 (130.8)	902.17 (166.46)	1070.79 (213.13)	246.83 (43.7)	348.55 (63.3)	460.64 (82.93)	538.16 (106.47)
		Th2	361.44 (77.81)	644.43 (128.7)	945.14 (182.41)	1096.22 (218.59)	211.93 (38.03)	343.34 (62.61)	478.1 (89.75)	546.76 (109.15)

Table B-30 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	671.9 (114.8)	936 (167.5)	1181.22 (226.65)	1312.34 (270.6)	336.7 (58.65)	428.41 (84.41)	507.59 (109.89)	549.11 (128.82)
		Th2	564.9 (106.2)	913.53 (170.77)	1212.1 (242.84)	1347.57 (285.94)	291.29 (52.43)	416.23 (85.77)	511.7 (116.9)	557.72 (131.9)
NC=50										
	CS=10	Th1	181.73 (45.82)	257.15 (63.45)	339.23 (86.08)	394.71 (98.38)	132.52 (26.1)	172.84 (34.65)	216.32 (46.6)	246.88 (52.8)
		Th2	155.98 (43.42)	254.41 (63.61)	359.54 (89.08)	407.32 (100.49)	117.33 (24.88)	170.99 (34.83)	226.88 (47.8)	253.4 (53.86)
	CS=50	Th1	691.15 (110.97)	1043.82 (159.15)	1412.02 (208.91)	1643.6 (240.6)	410.14 (60.33)	590.45 (85.42)	777.12 (115.48)	895.89 (133.34)
		Th2	566.94 (97.36)	1032.16 (158.94)	1495.37 (219.85)	1697.56 (250.38)	343.05 (53.16)	583.32 (86.17)	815.75 (121.43)	920.46 (139.74)
	CS=100	Th1	1162.15 (149.13)	1658.84 (220.05)	2112.06 (285.55)	2361.72 (336.47)	624.8 (87.95)	825.36 (134.27)	993.67 (172.02)	1082.13 (198.78)
		Th2	963.6 (140.17)	1625.85 (214.1)	2194.9 (289.86)	2416.04 (335.18)	527.32 (79.63)	804.46 (128.99)	1013.55 (174.08)	1095.36 (198.2)
NC=100										
	CS=10	Th1	301.02 (60.65)	435.82 (86.92)	570.13 (113.39)	647.83 (124.91)	219.22 (38.62)	295.72 (52.23)	369.92 (65.9)	414.03 (71.82)
		Th2	252.81 (57.15)	431.21 (86.69)	608.35 (117.35)	672 (129.55)	188.52 (36.8)	292.28 (51.87)	390.45 (67.39)	426.62 (73.98)
	CS=50	Th1	1327.05 (153.6)	2026.73 (216.59)	2696.58 (277.84)	3064.08 (304.47)	828.9 (93.44)	1213.15 (129)	1577.34 (167.24)	1783.35 (183.75)
		Th2	1081.73 (135.53)	2003.1 (220.93)	2868.57 (293.29)	3176.58 (318.38)	684.63 (82.41)	1196.65 (131.34)	1666.74 (174.49)	1838.36 (191.16)
	CS=100	Th1	2403.98 (210.52)	3541.21 (313.59)	4530.76 (402.86)	5027.44 (471.75)	1412.71 (135.98)	1967.46 (213.7)	2407.59 (282.78)	2612.04 (330.09)
		Th2	1969.24 (201.57)	3463.32 (298.75)	4740.83 (420.92)	5166.33 (481.2)	1172.96 (126.39)	1910.78 (208.07)	2478.43 (296.64)	2655.91 (329.66)

Note. MWBs = Simple misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-31

CFI Means and Standard Deviations (in parenthesis) for the MWBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.865 (0.063)	0.858 (0.053)	0.851 (0.048)	0.847 (0.046)	0.835 (0.08)	0.825 (0.068)	0.816 (0.062)	0.81 (0.06)
		Th2	0.868 (0.067)	0.858 (0.051)	0.852 (0.046)	0.848 (0.045)	0.84 (0.084)	0.826 (0.066)	0.817 (0.059)	0.812 (0.058)
	CS=50	Th1	0.897 (0.034)	0.903 (0.03)	0.907 (0.032)	0.909 (0.034)	0.885 (0.04)	0.895 (0.035)	0.902 (0.035)	0.904 (0.037)
		Th2	0.903 (0.036)	0.905 (0.033)	0.909 (0.032)	0.91 (0.034)	0.892 (0.042)	0.899 (0.037)	0.905 (0.035)	0.905 (0.037)
	CS=100	Th1	0.932 (0.035)	0.933 (0.037)	0.934 (0.041)	0.934 (0.041)	0.929 (0.037)	0.93 (0.04)	0.931 (0.043)	0.93 (0.044)
		Th2	0.938 (0.034)	0.934 (0.036)	0.934 (0.041)	0.934 (0.043)	0.935 (0.037)	0.931 (0.039)	0.93 (0.044)	0.93 (0.046)
NC=50										
	CS=10	Th1	0.854 (0.047)	0.85 (0.039)	0.847 (0.036)	0.844 (0.034)	0.818 (0.062)	0.812 (0.053)	0.807 (0.049)	0.803 (0.047)
		Th2	0.858 (0.049)	0.851 (0.039)	0.847 (0.035)	0.846 (0.033)	0.824 (0.065)	0.813 (0.053)	0.807 (0.047)	0.805 (0.045)
	CS=50	Th1	0.877 (0.027)	0.884 (0.024)	0.888 (0.024)	0.891 (0.025)	0.857 (0.034)	0.871 (0.03)	0.881 (0.028)	0.885 (0.029)
		Th2	0.882 (0.026)	0.886 (0.025)	0.891 (0.024)	0.892 (0.025)	0.862 (0.034)	0.875 (0.031)	0.885 (0.028)	0.887 (0.028)
	CS=100	Th1	0.902 (0.026)	0.907 (0.028)	0.91 (0.031)	0.91 (0.033)	0.898 (0.029)	0.904 (0.03)	0.907 (0.032)	0.906 (0.036)
		Th2	0.905 (0.028)	0.909 (0.031)	0.91 (0.032)	0.91 (0.034)	0.901 (0.031)	0.906 (0.033)	0.907 (0.034)	0.906 (0.037)
NC=100										
	CS=10	Th1	0.848 (0.032)	0.845 (0.028)	0.844 (0.025)	0.842 (0.024)	0.807 (0.044)	0.803 (0.04)	0.8 (0.036)	0.797 (0.035)
		Th2	0.851 (0.035)	0.846 (0.028)	0.844 (0.025)	0.843 (0.024)	0.812 (0.048)	0.804 (0.04)	0.799 (0.035)	0.798 (0.034)
	CS=50	Th1	0.864 (0.018)	0.868 (0.017)	0.872 (0.018)	0.875 (0.018)	0.83 (0.027)	0.844 (0.024)	0.854 (0.024)	0.86 (0.023)
		Th2	0.866 (0.019)	0.871 (0.018)	0.875 (0.018)	0.876 (0.018)	0.833 (0.028)	0.849 (0.025)	0.861 (0.024)	0.863 (0.024)
	CS=100	Th1	0.882 (0.021)	0.888 (0.022)	0.893 (0.025)	0.894 (0.026)	0.873 (0.025)	0.884 (0.025)	0.89 (0.027)	0.891 (0.029)
		Th2	0.883 (0.021)	0.889 (0.024)	0.894 (0.026)	0.895 (0.026)	0.874 (0.026)	0.884 (0.028)	0.892 (0.028)	0.892 (0.028)
Low-ICC										
NC=30										
	CS=10	Th1	0.872 (0.063)	0.856 (0.053)	0.847 (0.049)	0.84 (0.047)	0.849 (0.076)	0.828 (0.066)	0.815 (0.061)	0.806 (0.06)
		Th2	0.891 (0.071)	0.859 (0.053)	0.848 (0.047)	0.841 (0.047)	0.872 (0.085)	0.832 (0.065)	0.817 (0.059)	0.808 (0.059)
	CS=50	Th1	0.834 (0.034)	0.828 (0.032)	0.823 (0.029)	0.818 (0.032)	0.797 (0.045)	0.791 (0.042)	0.787 (0.038)	0.783 (0.041)
		Th2	0.842 (0.035)	0.83 (0.031)	0.824 (0.03)	0.819 (0.031)	0.807 (0.045)	0.794 (0.04)	0.79 (0.038)	0.785 (0.04)

Table B-31 *Continued*

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
	CS=100	Th1	0.824 (0.029)	0.823 (0.03)	0.823 (0.032)	0.821 (0.033)	0.794 (0.038)	0.799 (0.037)	0.803 (0.039)	0.804 (0.04)
		Th2	0.83 (0.031)	0.825 (0.031)	0.824 (0.033)	0.82 (0.034)	0.8 (0.039)	0.802 (0.038)	0.806 (0.04)	0.803 (0.04)
NC=50										
	CS=10	Th1	0.857 (0.045)	0.848 (0.039)	0.844 (0.037)	0.841 (0.036)	0.828 (0.057)	0.815 (0.051)	0.808 (0.049)	0.804 (0.047)
		Th2	0.867 (0.051)	0.852 (0.038)	0.847 (0.035)	0.843 (0.034)	0.841 (0.064)	0.82 (0.05)	0.811 (0.046)	0.806 (0.046)
	CS=50	Th1	0.834 (0.025)	0.83 (0.023)	0.826 (0.023)	0.824 (0.023)	0.791 (0.035)	0.787 (0.033)	0.784 (0.031)	0.782 (0.031)
		Th2	0.842 (0.025)	0.831 (0.023)	0.828 (0.022)	0.825 (0.022)	0.802 (0.035)	0.79 (0.032)	0.787 (0.03)	0.784 (0.03)
	CS=100	Th1	0.823 (0.022)	0.821 (0.022)	0.822 (0.022)	0.821 (0.024)	0.784 (0.03)	0.789 (0.03)	0.796 (0.03)	0.798 (0.031)
		Th2	0.829 (0.023)	0.823 (0.022)	0.823 (0.023)	0.821 (0.023)	0.79 (0.032)	0.792 (0.03)	0.799 (0.03)	0.799 (0.03)
NC=100										
	CS=10	Th1	0.852 (0.03)	0.847 (0.027)	0.845 (0.026)	0.844 (0.025)	0.818 (0.039)	0.811 (0.036)	0.807 (0.035)	0.805 (0.034)
		Th2	0.859 (0.034)	0.851 (0.027)	0.848 (0.024)	0.846 (0.024)	0.829 (0.044)	0.815 (0.037)	0.81 (0.033)	0.807 (0.033)
	CS=50	Th1	0.836 (0.016)	0.832 (0.016)	0.831 (0.015)	0.83 (0.015)	0.788 (0.025)	0.784 (0.024)	0.783 (0.022)	0.783 (0.022)
		Th2	0.843 (0.017)	0.834 (0.015)	0.832 (0.015)	0.83 (0.015)	0.798 (0.026)	0.787 (0.023)	0.786 (0.022)	0.784 (0.022)
	CS=100	Th1	0.826 (0.015)	0.824 (0.015)	0.824 (0.016)	0.824 (0.016)	0.778 (0.023)	0.78 (0.022)	0.786 (0.023)	0.788 (0.024)
		Th2	0.832 (0.016)	0.825 (0.015)	0.825 (0.016)	0.824 (0.016)	0.784 (0.024)	0.783 (0.023)	0.79 (0.023)	0.79 (0.024)

Note. MWBs = Simple misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-32

TLI Means and Standard Deviations (in parenthesis) for the MWBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.817 (0.087)	0.806 (0.072)	0.797 (0.066)	0.791 (0.063)	0.776 (0.110)	0.761 (0.093)	0.749 (0.085)	0.741 (0.082)
		Th2	0.822 (0.095)	0.807 (0.070)	0.798 (0.062)	0.793 (0.061)	0.783 (0.118)	0.762 (0.091)	0.750 (0.080)	0.744 (0.078)
	CS=50	Th1	0.860 (0.046)	0.867 (0.041)	0.873 (0.044)	0.876 (0.046)	0.844 (0.055)	0.857 (0.047)	0.866 (0.048)	0.870 (0.050)
		Th2	0.868 (0.049)	0.871 (0.045)	0.876 (0.043)	0.877 (0.046)	0.852 (0.058)	0.862 (0.050)	0.871 (0.047)	0.871 (0.050)
	CS=100	Th1	0.908 (0.047)	0.909 (0.051)	0.911 (0.056)	0.909 (0.056)	0.904 (0.051)	0.905 (0.054)	0.906 (0.059)	0.904 (0.060)
		Th2	0.915 (0.047)	0.910 (0.050)	0.910 (0.056)	0.911 (0.058)	0.911 (0.050)	0.906 (0.053)	0.905 (0.060)	0.905 (0.063)
NC=50										
	CS=10	Th1	0.800 (0.064)	0.795 (0.054)	0.791 (0.049)	0.788 (0.047)	0.751 (0.085)	0.743 (0.073)	0.737 (0.067)	0.731 (0.064)
		Th2	0.807 (0.067)	0.797 (0.054)	0.792 (0.047)	0.789 (0.045)	0.760 (0.088)	0.746 (0.073)	0.737 (0.065)	0.734 (0.062)
	CS=50	Th1	0.833 (0.036)	0.841 (0.033)	0.848 (0.033)	0.851 (0.035)	0.805 (0.047)	0.824 (0.041)	0.837 (0.039)	0.843 (0.040)
		Th2	0.839 (0.036)	0.844 (0.034)	0.852 (0.033)	0.853 (0.034)	0.812 (0.046)	0.830 (0.042)	0.844 (0.038)	0.846 (0.039)
	CS=100	Th1	0.867 (0.035)	0.873 (0.038)	0.877 (0.042)	0.877 (0.046)	0.861 (0.039)	0.869 (0.041)	0.873 (0.044)	0.872 (0.049)
		Th2	0.871 (0.038)	0.876 (0.042)	0.878 (0.044)	0.877 (0.047)	0.865 (0.042)	0.872 (0.045)	0.873 (0.047)	0.872 (0.050)
NC=100										
	CS=10	Th1	0.793 (0.043)	0.789 (0.038)	0.787 (0.034)	0.785 (0.033)	0.737 (0.060)	0.731 (0.054)	0.727 (0.049)	0.723 (0.047)
		Th2	0.797 (0.048)	0.791 (0.038)	0.787 (0.033)	0.786 (0.033)	0.744 (0.066)	0.733 (0.054)	0.726 (0.048)	0.724 (0.047)
	CS=50	Th1	0.814 (0.025)	0.820 (0.023)	0.825 (0.024)	0.829 (0.024)	0.768 (0.037)	0.787 (0.033)	0.801 (0.033)	0.809 (0.032)
		Th2	0.818 (0.026)	0.824 (0.024)	0.829 (0.025)	0.831 (0.025)	0.773 (0.038)	0.794 (0.034)	0.810 (0.032)	0.814 (0.032)
	CS=100	Th1	0.839 (0.029)	0.848 (0.030)	0.854 (0.034)	0.855 (0.036)	0.827 (0.035)	0.841 (0.034)	0.850 (0.037)	0.852 (0.039)
		Th2	0.841 (0.029)	0.848 (0.033)	0.855 (0.035)	0.856 (0.036)	0.828 (0.035)	0.842 (0.038)	0.852 (0.038)	0.853 (0.039)
Low-ICC										
NC=30										
	CS=10	Th1	0.826 (0.087)	0.804 (0.073)	0.791 (0.066)	0.782 (0.065)	0.795 (0.106)	0.765 (0.090)	0.748 (0.084)	0.736 (0.082)
		Th2	0.854 (0.103)	0.808 (0.072)	0.793 (0.064)	0.783 (0.064)	0.829 (0.123)	0.771 (0.089)	0.751 (0.081)	0.738 (0.081)
	CS=50	Th1	0.774 (0.046)	0.766 (0.043)	0.758 (0.039)	0.752 (0.044)	0.723 (0.061)	0.715 (0.057)	0.709 (0.051)	0.705 (0.056)
		Th2	0.785 (0.047)	0.769 (0.042)	0.760 (0.041)	0.753 (0.043)	0.737 (0.062)	0.719 (0.055)	0.713 (0.052)	0.706 (0.054)

Table B-32 *Continued*

Number of Cluster	Cluster Size	TH	WLSM				WLSMV			
			2-cat	3-cat	5-cat	7-cat	2-cat	3-cat	5-cat	7-cat
	CS=100	Th1	0.760 (0.040)	0.758 (0.040)	0.758 (0.044)	0.756 (0.046)	0.719 (0.051)	0.725 (0.050)	0.731 (0.054)	0.732 (0.055)
		Th2	0.769 (0.042)	0.762 (0.042)	0.760 (0.044)	0.755 (0.046)	0.727 (0.054)	0.730 (0.052)	0.735 (0.055)	0.731 (0.055)
NC=50										
	CS=10	Th1	0.805 (0.062)	0.793 (0.053)	0.787 (0.051)	0.783 (0.049)	0.765 (0.078)	0.748 (0.069)	0.739 (0.067)	0.733 (0.065)
		Th2	0.818 (0.070)	0.798 (0.052)	0.791 (0.047)	0.786 (0.047)	0.783 (0.087)	0.754 (0.068)	0.743 (0.063)	0.736 (0.063)
	CS=50	Th1	0.773 (0.034)	0.768 (0.032)	0.763 (0.031)	0.760 (0.031)	0.715 (0.048)	0.710 (0.045)	0.706 (0.043)	0.703 (0.043)
		Th2	0.784 (0.034)	0.770 (0.032)	0.765 (0.030)	0.761 (0.031)	0.730 (0.048)	0.713 (0.044)	0.710 (0.041)	0.706 (0.042)
	CS=100	Th1	0.759 (0.030)	0.756 (0.030)	0.757 (0.031)	0.756 (0.033)	0.706 (0.041)	0.712 (0.041)	0.722 (0.041)	0.725 (0.043)
		Th2	0.766 (0.032)	0.759 (0.030)	0.759 (0.031)	0.756 (0.032)	0.714 (0.044)	0.717 (0.041)	0.726 (0.041)	0.726 (0.042)
NC=100										
	CS=10	Th1	0.798 (0.041)	0.792 (0.037)	0.789 (0.035)	0.787 (0.034)	0.752 (0.054)	0.742 (0.049)	0.737 (0.048)	0.734 (0.047)
		Th2	0.807 (0.046)	0.796 (0.037)	0.793 (0.033)	0.790 (0.033)	0.766 (0.060)	0.748 (0.050)	0.741 (0.045)	0.737 (0.045)
	CS=50	Th1	0.776 (0.022)	0.771 (0.021)	0.769 (0.020)	0.768 (0.020)	0.712 (0.035)	0.706 (0.032)	0.705 (0.031)	0.704 (0.030)
		Th2	0.786 (0.023)	0.774 (0.021)	0.771 (0.020)	0.768 (0.020)	0.724 (0.035)	0.710 (0.031)	0.708 (0.030)	0.705 (0.030)
	CS=100	Th1	0.763 (0.021)	0.759 (0.021)	0.760 (0.021)	0.760 (0.022)	0.697 (0.032)	0.701 (0.031)	0.709 (0.031)	0.711 (0.032)
		Th2	0.770 (0.022)	0.762 (0.021)	0.762 (0.021)	0.760 (0.022)	0.706 (0.033)	0.705 (0.031)	0.714 (0.032)	0.713 (0.033)

Note. MWBs = Simple misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.

Table B-33

RMSEA Means and Standard Deviations (in parenthesis) for the MWBs by EST, ICC, CAT, NC, CS, and TH

Number of Cluster	Cluster Size	TH	WLSM 2-cat	WLSM 3-cat	WLSM 5-cat	WLSM 7-cat	WLSMV 2-cat	WLSMV 3-cat	WLSMV 5-cat	WLSMV 7-cat
High-ICC										
NC=30										
	CS=10	Th1	0.053 (0.017)	0.070 (0.018)	0.087 (0.019)	0.097 (0.020)	0.037 (0.012)	0.049 (0.012)	0.061 (0.013)	0.068 (0.014)
		Th2	0.049 (0.018)	0.071 (0.018)	0.092 (0.019)	0.100 (0.020)	0.034 (0.012)	0.050 (0.012)	0.064 (0.013)	0.070 (0.014)
	CS=50	Th1	0.035 (0.007)	0.04 0(0.008)	0.043 (0.009)	0.044 (0.010)	0.022 (0.005)	0.024 (0.005)	0.026 (0.006)	0.026 (0.006)
		Th2	0.032 (0.007)	0.039 (0.008)	0.044 (0.009)	0.044 (0.010)	0.021 (0.005)	0.024 (0.005)	0.026 (0.006)	0.026 (0.006)
	CS=100	Th1	0.019 (0.006)	0.021 (0.007)	0.022 (0.008)	0.023 (0.008)	0.011 (0.004)	0.012 (0.004)	0.012 (0.004)	0.012 (0.005)
		Th2	0.017 (0.006)	0.021 (0.007)	0.023 (0.008)	0.023 (0.009)	0.010 (0.004)	0.012 (0.004)	0.013 (0.004)	0.012 (0.005)
NC=50										
	CS=10	Th1	0.057 (0.012)	0.072 (0.012)	0.086 (0.014)	0.094 (0.014)	0.042 (0.009)	0.053 (0.009)	0.063 (0.010)	0.069 (0.010)
		Th2	0.052 (0.012)	0.073 (0.013)	0.091 (0.014)	0.097 (0.015)	0.039 (0.009)	0.054 (0.009)	0.067 (0.010)	0.071 (0.010)
	CS=50	Th1	0.042 (0.005)	0.048 (0.006)	0.053 (0.007)	0.055 (0.007)	0.029 (0.004)	0.031 (0.005)	0.033 (0.005)	0.034 (0.005)
		Th2	0.039 (0.005)	0.048 (0.006)	0.054 (0.007)	0.055 (0.007)	0.027 (0.004)	0.031 (0.005)	0.034 (0.005)	0.034 (0.005)
	CS=100	Th1	0.028 (0.004)	0.030 (0.005)	0.032 (0.006)	0.033 (0.006)	0.016 (0.003)	0.017 (0.003)	0.018 (0.004)	0.019 (0.004)
		Th2	0.026 (0.004)	0.030 (0.005)	0.033 (0.006)	0.034 (0.007)	0.015 (0.003)	0.017 (0.003)	0.019 (0.004)	0.019 (0.004)
NC=100										
	CS=10	Th1	0.058 (0.008)	0.072 (0.008)	0.085 (0.009)	0.092 (0.009)	0.046 (0.006)	0.056 (0.006)	0.065 (0.007)	0.070 (0.007)
		Th2	0.054 (0.008)	0.074 (0.009)	0.091 (0.010)	0.095 (0.010)	0.042 (0.006)	0.057 (0.006)	0.069 (0.007)	0.072 (0.007)
	CS=50	Th1	0.048 (0.004)	0.056 (0.004)	0.063 (0.005)	0.066 (0.005)	0.036 (0.003)	0.040 (0.004)	0.044 (0.004)	0.045 (0.004)
		Th2	0.044 (0.004)	0.056 (0.004)	0.065 (0.005)	0.067 (0.006)	0.033 (0.003)	0.040 (0.004)	0.044 (0.004)	0.045 (0.005)
	CS=100	Th1	0.035 (0.003)	0.040 (0.004)	0.043 (0.005)	0.045 (0.006)	0.023 (0.003)	0.025 (0.003)	0.026 (0.003)	0.026 (0.004)
		Th2	0.033 (0.003)	0.040 (0.004)	0.044 (0.005)	0.045 (0.006)	0.021 (0.002)	0.024 (0.003)	0.026 (0.004)	0.026 (0.004)
Low-ICC										
NC=30										
	CS=10	Th1	0.054 (0.018)	0.074 (0.018)	0.092 (0.020)	0.104 (0.021)	0.038 (0.013)	0.052 (0.013)	0.065 (0.014)	0.073 (0.015)
		Th2	0.043 (0.021)	0.073 (0.018)	0.096 (0.020)	0.106 (0.021)	0.030 (0.015)	0.051 (0.013)	0.067 (0.014)	0.075 (0.015)
	CS=50	Th1	0.060 (0.007)	0.077 (0.009)	0.091 (0.009)	0.100 (0.011)	0.042 (0.005)	0.053 (0.006)	0.063 (0.007)	0.069 (0.008)
		Th2	0.054 (0.007)	0.076 (0.008)	0.094 (0.010)	0.101 (0.011)	0.038 (0.005)	0.053 (0.006)	0.064 (0.007)	0.069 (0.008)

Table B-33 *Continued*

Number of Cluster	Cluster Size	TH	WLSM				WLSMV			
			2-cat	3-cat	5-cat	7-cat	2-cat	3-cat	5-cat	7-cat
	CS=100	Th1	0.055 (0.005)	0.066 (0.006)	0.075 (0.008)	0.079 (0.009)	0.037 (0.004)	0.042 (0.005)	0.047 (0.006)	0.049 (0.007)
		Th2	0.050 (0.005)	0.065 (0.007)	0.076 (0.008)	0.080 (0.009)	0.034 (0.004)	0.042 (0.005)	0.047 (0.006)	0.049 (0.007)
NC=50										
	CS=10	Th1	0.058 (0.012)	0.075 (0.013)	0.090 (0.014)	0.099 (0.015)	0.044 (0.009)	0.056 (0.009)	0.067 (0.011)	0.073 (0.011)
		Th2	0.051 (0.013)	0.074 (0.013)	0.093 (0.014)	0.101 (0.015)	0.038 (0.010)	0.056 (0.010)	0.069 (0.010)	0.075 (0.011)
	CS=50	Th1	0.061 (0.005)	0.077 (0.006)	0.090 (0.007)	0.097 (0.007)	0.045 (0.004)	0.056 (0.005)	0.065 (0.005)	0.071 (0.006)
		Th2	0.055 (0.005)	0.076 (0.006)	0.093 (0.007)	0.099 (0.008)	0.041 (0.004)	0.056 (0.005)	0.067 (0.005)	0.072 (0.006)
	CS=100	Th1	0.058 (0.004)	0.069 (0.005)	0.079 (0.005)	0.083 (0.006)	0.041 (0.003)	0.048 (0.004)	0.053 (0.005)	0.055 (0.005)
		Th2	0.052 (0.004)	0.069 (0.005)	0.080 (0.005)	0.084 (0.006)	0.037 (0.003)	0.047 (0.004)	0.053 (0.005)	0.056 (0.005)
NC=100										
	CS=10	Th1	0.059 (0.008)	0.074 (0.009)	0.087 (0.010)	0.093 (0.010)	0.048 (0.006)	0.059 (0.007)	0.067 (0.007)	0.072 (0.007)
		Th2	0.053 (0.008)	0.074 (0.009)	0.090 (0.010)	0.095 (0.010)	0.043 (0.006)	0.058 (0.007)	0.070 (0.007)	0.074 (0.008)
	CS=50	Th1	0.062 (0.004)	0.077 (0.004)	0.089 (0.005)	0.095 (0.005)	0.048 (0.003)	0.059 (0.003)	0.068 (0.004)	0.072 (0.004)
		Th2	0.055 (0.004)	0.076 (0.004)	0.092 (0.005)	0.097 (0.005)	0.043 (0.003)	0.058 (0.003)	0.070 (0.004)	0.073 (0.004)
	CS=100	Th1	0.059 (0.003)	0.072 (0.003)	0.082 (0.004)	0.087 (0.004)	0.045 (0.002)	0.054 (0.003)	0.059 (0.004)	0.062 (0.004)
		Th2	0.054 (0.003)	0.072 (0.003)	0.084 (0.004)	0.088 (0.004)	0.041 (0.002)	0.053 (0.003)	0.060 (0.004)	0.063 (0.004)

Note. MWBs = Simple misspecified within- and between-level models. WLSM = Weighted least square mean. WLSMV = Weighted least square mean and variance. High ICC = High Intra-Class Correlation; Low ICC = Low Intra-Class Correlation; NC = Number of Clusters; CS = Cluster Size; Th1 = Balanced Threshold Structure; Th2 = Skewed Threshold Structure. –cat = number of categories.